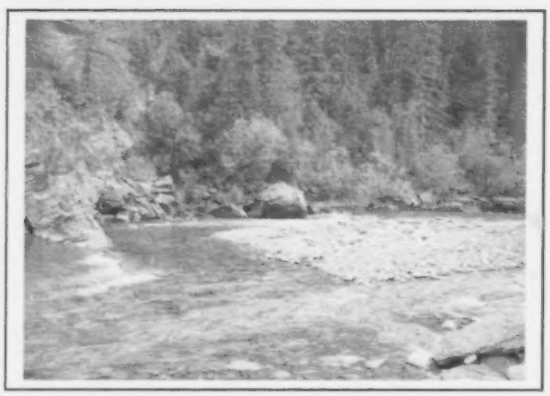
alberta's species at risk program

Bull Trout
Conservation Management Plan
2012 - 2017



Alberta Conservation Management Plan No. 8

Government of Alberta

Bull Trout

Conservation Management Plan

2012 -2017

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PREFACE

Albertans are fortunate to share their province with a diversity of wild species. A small number of these species are classified as Species of Special Concern because they have characteristics that make them particularly sensitive to human activities or natural events. Special conservation measures are necessary to ensure that these species do not become Endangered or Threatened.

Conservation management plans are developed for Species of Special Concern to provide guidance for land and resource management decisions that affect the species and their habitat. These plans are intended to be a resource tool for Sustainable Resource Development - Fish and Wildlife Division (SRD-FWD) and for provincial and regional land and resource management staff.

Conservation management plans provide background information including species biology, threats to species and habitat, and inventory/monitoring history. Plans also provide a goal, objectives, and actions (management recommendations). Management recommendations are typically categorised into inventory and monitoring needs; habitat management and conservation; education and communication; and additional management considerations as required.

Conservation management plans are generally prepared by an SRD-FWD biologist who has been designated as the provincial species lead. Writers from outside SRD-FWD are occasionally sought to prepare plans for species for which there is little in-house expertise. In order to ensure accuracy and utility, each plan is reviewed by a species expert and a designated provincial representative from SRD Forestry Division and/or Lands Division. In some cases there may be additional reviewers from staff, industry, and other agencies. In this case, the opportunity to review the draft plan was extended to all First Nations in Alberta. Conservation management plans are internal guidance documents. They are implemented under the guidance of the species lead and are "living" documents that can be revised at any time as required. Conservation management plans are generally more succinct than the recovery plans that are prepared for Endangered and Threatened species and do not involve participation of a multi-stakeholder team.

Conservation management plans are approved by the Director of Wildlife and/or Director of Fisheries. Plans will be reviewed annually by the species lead and updated if necessary, and a more in-depth review will occur five years after a plan's approval.

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EXECUTIVE SUMMARY

Bull trout (*Salvelinus confluentus*), the Provincial Fish of Alberta, are a native species that occurs in all of the major river basins of the Province. In response to rapidly declining bull trout populations, the Fisheries Management Branch produced the first Alberta Bull Trout Management and Recovery Plan in 1994, which provided a framework for management and recovery. In 2002, bull trout were listed under the Wildlife Act as a *Species of Special Concern* because of the declines in distribution and abundance, as well as continued threats from habitat alteration and introduced competitive species.

Over the past 15 years bull trout have been the subject of research, inventory and management efforts in Alberta, B.C. and the U.S. that have resulted in a significant body of work defining bull trout ecology, population status, habitat requirements and the impacts of development and recreational activities as well as introduced competitive species.

Bull trout still occur in all of the major watersheds of the eastern slopes in Alberta, but have experienced significant reductions in both range and numbers, including the loss of some populations. Historical distribution has been estimated at approximately 24,000 stream kilometres, while current distribution is estimated at approximately 16,000 km – a 33% reduction in range. Generally, bull trout populations in the southern watersheds – Oldman, Bow and Red Deer rivers – have experienced the greatest declines. In the North Saskatchewan, Athabasca and Peace-Smoky watersheds, bull trout occur in higher numbers, but still below historic levels in most locations.

Fisheries Management Branch biologists have classified 128 bull trout subpopulations (believed to be genetically distinct stocks) into 51 core areas – including a minimum of 11 extirpated subpopulations and 3 extirpated core areas. A conservation risk assessment ranked 78% of the core areas as ***high risk*** (*highly vulnerable*) or ***at risk*** (*vulnerable*), 16% were ranked as ***potential risk*** and 6% were classified as **extirpated;** no core areas were ranked as ***low risk***. Short-term population trends indicate approximately 61% of core populations are in a state of decline while 39% are considered stable or increasing. An assessment of the recovery potential for bull trout core areas showed that only 66% had a moderate to high recovery potential, while the remainder had a low, no or unknown chance of recovery.

Where bull trout recovery has occurred, it has been largely due to angling regulation changes and related management activities including: (1) zero harvest limit, (2) bait bans, (3) seasonal and permanent angling closures in key spawning, staging and overwintering areas, (4) public awareness and education efforts to reduce fish misidentification and unintentional harvest, and (5) enforcement efforts to reduce illegal harvest.

The fact that many bull trout populations have not recovered, or are still considered vulnerable, has largely been a consequence of the increasing cumulative impacts of industrial and recreational activities within the species historic range as well as

competition from introduced fish species. Conserving healthy aquatic ecosystems requires the adoption of disturbance thresholds that will not be exceeded, and a commitment to restoration and protection of degraded habitats.

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1.0 INTRODUCTION

The first Alberta Bull Trout Management and Recovery Plan was produced in 1994 by the Fisheries Management Branch in response to rapidly declining populations (Berry, 1994). The Plan recommended a *Species of Special Concern* status, the establishment of a provincial zero harvest limit (i.e., catch and release only) and the implementation of research and inventory projects to define bull trout ecology, population status, habitat requirements and impacts of industrial and recreational activities. In addition, the Plan identified the urgent need to raise public awareness about the status of bull trout. Efforts by the multi-stakeholder Bull Trout Task Force (1993 – 1997), the Fisheries Management Branch, and the Alberta Conservation Association have resulted in significant progress towards these goals. Initial efforts and research were presented in bull trout conferences held in Alberta in 1994 and 1999 (see Mackay et al. 1997; and Brewin and Monita, 2001).

In addition to this Conservation Management Plan, the Alberta Wildlife Status Report Series – *Status of the Bull Trout in Alberta: Update 2009* (Rodtka 2009), produced by the Alberta Conservation Association in partnership with Alberta Fish and Wildlife Division, provides a comprehensive summary of the biological and conservation status of bull trout populations and habitats in Alberta.

1.1 Provincial and National Status

In 2002, Alberta's Minister of Sustainable Resource Development (the Minister) approved the listing of bull trout as a *Species of Special Concern* under Alberta's *Wildlife Act* based on the recommendation from the provincial Endangered Species Conservation Committee (ESCC). This designation resulted from declines in distribution (loss of range) and abundance, as well as continued threats from habitat alteration and introduced competitive species.

Nationally, the status of bull trout is currently being examined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). A draft status report is scheduled for completion in 2012.

Bull trout status in other jurisdictions includes:

- Listed in British Columbia as a *Species of Special Concern* (blue listed).
- *Sensitive* in Yukon
- *May Be At Risk* in North West Territories
- Listed by the U.S. Fish and Wildlife Service as *Threatened* throughout its range in the coterminous United States.
- Globally ranked as G3 – *Vulnerable* by NatureServe (an international network of 82 independent biological data centers located in the western hemisphere).

2.0 SPECIES BIOLOGY

2.1 Classification and Description

Bull trout (*Salvelinus confluentus*) belong to a branch of the *Salmonidae* family called chars – *Salvelinus*. There are two native char species found in Alberta – bull trout and lake trout (*Salvelinus namaycush*). The only other commonly found char in Alberta is brook trout (*Salvelinus fontinalis*), a widely established non-native species that was stocked throughout the eastern slopes and mountain national parks during the 1900s.

Bull trout are typically long, slender fish with a broad, flat head and large jaws. The back and sides are dark, but may be silvery in lake populations, with rounded pale spots which may be yellow, orange or pink. They have pale bellies which may turn bright orange or red in spawning males. The tail fin is only slightly forked and the lower fins have a white leading edge that is not sharply offset by a black stripe.

Bull trout are frequently mistaken for brook trout, or identified simply as trout when caught by anglers. They can be distinguished from other stream-dwelling char and trout in Alberta by the ***absence of black markings on the dorsal fin***. This field mark has been utilized for the public education campaign ***"No black – put it back"*** which has helped to reduce angler misidentification.

Until fairly recently, bull trout and Dolly Varden (*Salvelinus malma*) were thought to be the same species because of their strikingly close physical appearance, but they are now known to be distinct species. The only population of Dolly Varden found in Alberta was introduced to Chester Lake in 1974 - a small high mountain lake in Kananaskis Country. Many Albertans still mistakenly refer to bull trout as Dolly Varden.

Bull trout x brook trout hybrids are known to occur in Alberta. Physical features are intermediate between the two species. The dorsal fin of hybrids have either pale spots or faint dark markings, but lack the prominent black markings of a brook trout dorsal fin, or the absence of black markings of a bull trout dorsal fin.

2.2 Distribution

Bull trout are native to the streams, rivers and lakes in the cordillera region of western and northern Canada and the U.S. Pacific Northwest. Bull trout are a cold-water species that are believed to have colonized a more extensive range than most other inland salmonids by dispersing through postglacial headwater connections between watersheds. Historically, bull trout and mountain whitefish occurred in all watersheds originating in Alberta's eastern slopes, while their distribution only overlapped with that of westslope cutthroat trout in the Bow and Oldman drainages of southern Alberta.

In Alberta, bull trout were common and widely distributed prior to settlement. Bull trout range extended from the mountains and foothills out into the parkland and prairies, being

reported as far east as Lethbridge in the Oldman River, Carseland in the Bow River, Morrin in the Red Deer River and Edmonton in the North Saskatchewan River (Figure 1).

Figure 1. Current and historical bull trout range in Alberta (also appears in Rodtka, 2009).

Historically, bull trout suffered from intentional eradication measures and overfishing. Since that time, increasingly degraded and fragmented habitats, and competition from introduced species continues to impact bull trout populations. Bull trout still occur in all of the major eastern slopes watersheds, but have experienced significant reductions in both range and numbers, including the loss of some populations. Historical distribution has been estimated at approximately 24,000 stream kilometres, while current distribution is estimated at approximately 16,000 km – a 33% reduction in range. Generally, bull trout populations in the southern watersheds – Oldman, Bow and Red Deer rivers – have experienced the greatest declines. In the North Saskatchewan, Athabasca and Peace-Smoky watersheds, bull trout occur in higher numbers, but below historic levels in most locations.

2.3 Life-History and Habitats

Bull trout are a cold-water species whose occurrence is associated with thermal gradients in streams. Generally, bull trout occur at highest densities in stream reaches with maximum temperatures of 12° – 13°C, are uncommon above 15°C, and absent in stream reaches above 18°C (references in Rodtka 2009).

Bull trout can have relatively long life spans (10 – 20 years). Growth rates in bull trout populations are variable depending on life-history strategy, habitat conditions and geographical location. Bull trout tend to grow slower and live longer in northern areas, at higher elevations and in smaller streams. Adult bull trout are piscivorous and an abundance of forage fish populations is important to maintain bull trout populations.

Bull trout express three different life-history strategies in Alberta. One is the non-migratory form – stream-resident – and two are migratory forms – fluvial (river), and adfluvial (lake/reservoir). Bull trout populations with different life-history strategies coexist in watersheds, but form genetically distinct stocks (subpopulations). Home range size is highly variable between life-history types and individual populations.

1) **Stream-resident bull trout** populations permanently reside in the small, cold tributary streams in which they spawn and rear. These populations can be connected to, or be partially or fully isolated from, migrant populations by natural barriers. Home ranges are typically small, moving within tributary stream networks to access spawning sites or deeper pools for overwintering. Stream-resident bull trout are strongly associated with pool habitat, instream and overhead cover. Stream-resident bull trout typically exhibit lower growth rates than migrant populations and seldom attain body sizes exceeding 30 cm.

2) **Fluvial bull trout** populations occupy rivers and major tributaries, moving into smaller tributaries to spawn and rear as juveniles. These populations tend to be highly migratory, displaying some of the largest home ranges, in some instances travelling long distances (250 km) to access spawning grounds (Burrows et al. 2001), or to disperse as juveniles to alternate rearing streams (150 km) (Warnock 2008).

However, other fluvial populations with spawning, rearing and overwintering habitat sites closely spaced can have moderate sized home ranges.

Adult fluvial bull trout utilize deep pools that provide thermal refuge and cover in the summer, and frazil ice-free refuge in the winter. In very large rivers (i.e., Peace, Athabasca rivers), pools are less important and bull trout utilize deeper, low velocity areas with instream cover and turbid water. Some bull trout show fidelity to overwintering sites, returning to the same area following spawning (Carson 2001).

Fluvial populations have higher growth rates and attain greater body sizes than stream-resident populations. Fluvial adults average 40 – 60 cm and 1 – 2 kg, and can grow relatively large, ranging in size from 60 – 80+ cm and 2 – 5+ kg (Alberta Fish and Wildlife, unpublished data) The migratory life-history strategy is a successful adaptation that allows bull trout to maximize use of widely separated habitat sites to meet their life-history needs. The majority of Alberta's eastern slope rivers still contain fluvial bull trout populations; however, Bow River fluvial populations have been extirpated.

3) **Adfluvial bull trout** populations reside in lakes and move into tributaries to spawn. Lakes can vary from small high mountain lakes (e.g., Pinto Lake) to large lower elevation lakes and reservoirs (e.g., Oldman River Reservoir). Migration for spawning may vary from short movements to inlet/outlet streams or longer movements to more distant spawning areas before returning to overwinter in the lake or reservoir.

   Adfluvial populations shift use of lacustrine habitats with the season and changes in water temperatures (MBTSG, 1998). In isothermal conditions, bull trout tend to be more evenly distributed but seek deeper, cooler water in the summer. They are nocturnal, typically resting near the bottom during the day and make foraging runs into the littoral zone at night. Adfluvial populations can attain the largest body size of the three life-history types. The large differences in body sizes between the three life-history types have important management implications (Rodtka 2009).

Bull trout play an important role as an apex, large-bodied predator in native fish communities. Bull trout were introduced to Upper Kananaskis Lake in 2001 and 2003 from Lower Kananaskis Lake stock and by 2007, gill net catch rates of longnose and white suckers had declined, relative to 1986 catch rates, by approximately 80%, establishing a new balance in the fish community (Alberta Fisheries Management Branch, unpublished data).

This variation in bull trout life strategies can dictate the application of different fisheries and/or habitat management strategies. For example, it could mean establishing different angling size limit regulations, depending on whether a population is resident or fluvial/adfluvial.

2.4 Reproduction

Bull trout are slow growing and late maturing with age at first spawning ranging from five to seven years. In migratory populations, movements to spawning areas occur during the summer months, generally at night, with bull trout often staging in large pools or near the mouths of spawning tributaries. Like all char, bull trout are fall spawners. Spawning can occur from mid-August to early October, with peak spawning times varying somewhat between geographical locations. Spawning activity is thought to be initiated when water temperatures decline below 9°C. A decline in photoperiod may also be an environmental cue (McPhail and Baxter 1996).

Once mature, bull trout typically spawn annually; however, in some populations alternate year spawning may occur, which influences the size of annual spawning runs. Variance in spawning run magnitude is more pronounced in small populations than large ones (Tchir 2001).

Bull trout utilize highly specific spawning sites in gravel substrates with low levels of fine sediment and high interstitial flow. A critical feature of high-quality spawning sites is groundwater influence where the incubating eggs benefit from stable flows, warmer water temperature in winter and lack of anchor ice. Bull trout show a high degree of fidelity to spawning areas (Rhude and Rhem 1995). High-quality spawning habitat is a critical component to sustaining healthy populations. Many of these sites are designated as 'Class A" waterbodies under the *Alberta Water Act* (Alberta Environment, 2007). The *Water Act, Codes of Practice* restrict development activity in or adjacent to Class A waters.

Egg production is a function of female body size and condition. Smaller, stream-resident females generally produce about 500 eggs while larger females from fluvial or adfluvial populations may produce 2000 – 5000 eggs. Egg incubation requires temperatures less than 8°C, with an optimal range of 2° – 4°C. Eggs incubate over winter within gravel interstitial spaces and the fry emerge in early spring, approximately seven months after fertilization. The prolonged incubation period makes bull trout eggs vulnerable to sedimentation, disturbance, low winter flows and freezing.

Depth and location of egg deposition can also influence survival. Larger sized spawning individuals can bury eggs deeper (DeVries 1997) and in coarser substrates located towards the center of the channel, promoting egg survival by reducing the potential for freezing or desiccation due to low flows (Berry 1994; Fairless et al. 1994). The retention of large female spawners in bull trout populations may improve incubation success.

2.5 Rearing

Bull trout fry are relatively inactive for the first few weeks after hatching, remaining in the gravel or along the bottom. Once fry achieve neutral buoyancy, they move to shallow,

low velocity areas with coarse substrates along the stream edge, in small pools or side channels and begin feeding on the smallest life stages of aquatic insects. Newly emerged fry are secretive and seek interstitial cover when disturbed.

Juveniles show a strong preference for pools, but also use runs and riffles with coarse substrates, large woody debris, or overhead cover and are frequently found using more than one cover type. Juveniles maintain positions near the bottom during the day, moving out at night. Their diet is largely aquatic insects, but starts to include fish when they reach approximately 10 – 11 cm in length. Fish become an increasingly important food source once juveniles migrate to rivers and lakes where prey fish are more abundant.

Juvenile bull trout may remain in or near their natal stream, or disperse to alternate rearing streams. Rearing streams are typically small, lower-order streams with optimal temperatures and fewer predators. However, rearing streams may have low carrying capacities due to their small size, higher elevations and lower water temperatures providing limited food and space. A population bottleneck can occur where suitable rearing streams are limited.

Juvenile dispersal in migrant populations is not well understood because of the difficulties in marking large numbers of small fish. However, genetic testing has shed new insights on the dispersal of juveniles from six migrant subpopulations in the Oldman River basin (Warnock 2008). Most juveniles made short-range dispersal movements within 10 km of their natal stream. Moderate-range dispersals of 32 – 53 km to alternate rearing streams occurred in all subpopulations. Long-range dispersals of 136 – 158 km were made by juveniles from three subpopulations to five alternate rearing streams across the basin. The proportion of juveniles that made moderate or long-range movements varied within each subpopulation, ranging from 12% to 47%, with a mean of 25%. The only resident subpopulation in the basin displayed a limited dispersal of juveniles, with only 4% of the juveniles moving more than 10 km.

Juvenile dispersal to alternate rearing streams may be a response to limited carrying capacity in the natal stream or other adaptive traits. In the Oldman River basin, Mill Creek has a moderate spawning run with excellent spawning conditions coupled with low rearing capacity and also had the highest proportion (47%) of juvenile dispersal (Warnock 2008). The presence of a resident brook trout population in the natal stream may also have influenced dispersal rates.

Generally, after one to four years, juveniles from fluvial or adfluvial populations migrate to rivers or lakes where they continue to grow for another three to five years before reaching sexual maturity.

2.6 Population Structure

The conservation of genetic diversity is a founding principle of biodiversity conservation and Alberta's Fish Conservation Strategy. Understanding the organizational structure of populations is a key component to conserving genetic diversity.

Bull trout populations can have a nested hierarchical population structure within major watersheds. At the finest level there are subpopulations (i.e., stocks) which are genetically distinct spawning aggregations. In many watersheds, two or more closely linked subpopulations share a mainstem river forming a population unit, defined as a core population. Groups of connected core populations which have some, but low levels, of genetic interchange, form a metapopulation.

While bull trout display a high fidelity to natal spawning areas, there is some switching between subpopulations which facilitates genetic interchange (admixture). With recent advances in genetic analyses, it is now possible to map the genetic relationship between populations. Research in the Oldman River basin (Warnock, 2008) measured moderate admixture rates of 19 – 35% between subpopulations (i.e., within core populations), and much lower admixture rates of 2.4 – 4.5% between core populations (i.e., within the metapopulation) (Figure 2).

It is estimated there were 128 bull trout subpopulations and 51 core populations historically in Alberta, with approximately 117 subpopulations and 48 core populations remaining. As more detailed genetic information becomes available, the number of subpopulations and core populations will be refined.

Within a metapopulation, a robust subpopulation can act as a source for other subpopulations, thus reducing the risk of local extinctions. In the Oldman River basin, mature bull trout were genetically tested for stream-of-origin from a number of sites (Warnock 2008). Bull trout from the fluvial/adfluvial Castle River core population made up 30% of the bull trout adults tested in the neighbouring Upper Oldman River core area. Conversely, bull trout adults from the Upper Oldman River were not found outside of the core area, indicating the Castle River bull trout may act as a source population. Identifying and maintaining source populations as a priority may help to rebuild depressed subpopulations and ensure the long-term persistence of bull trout.

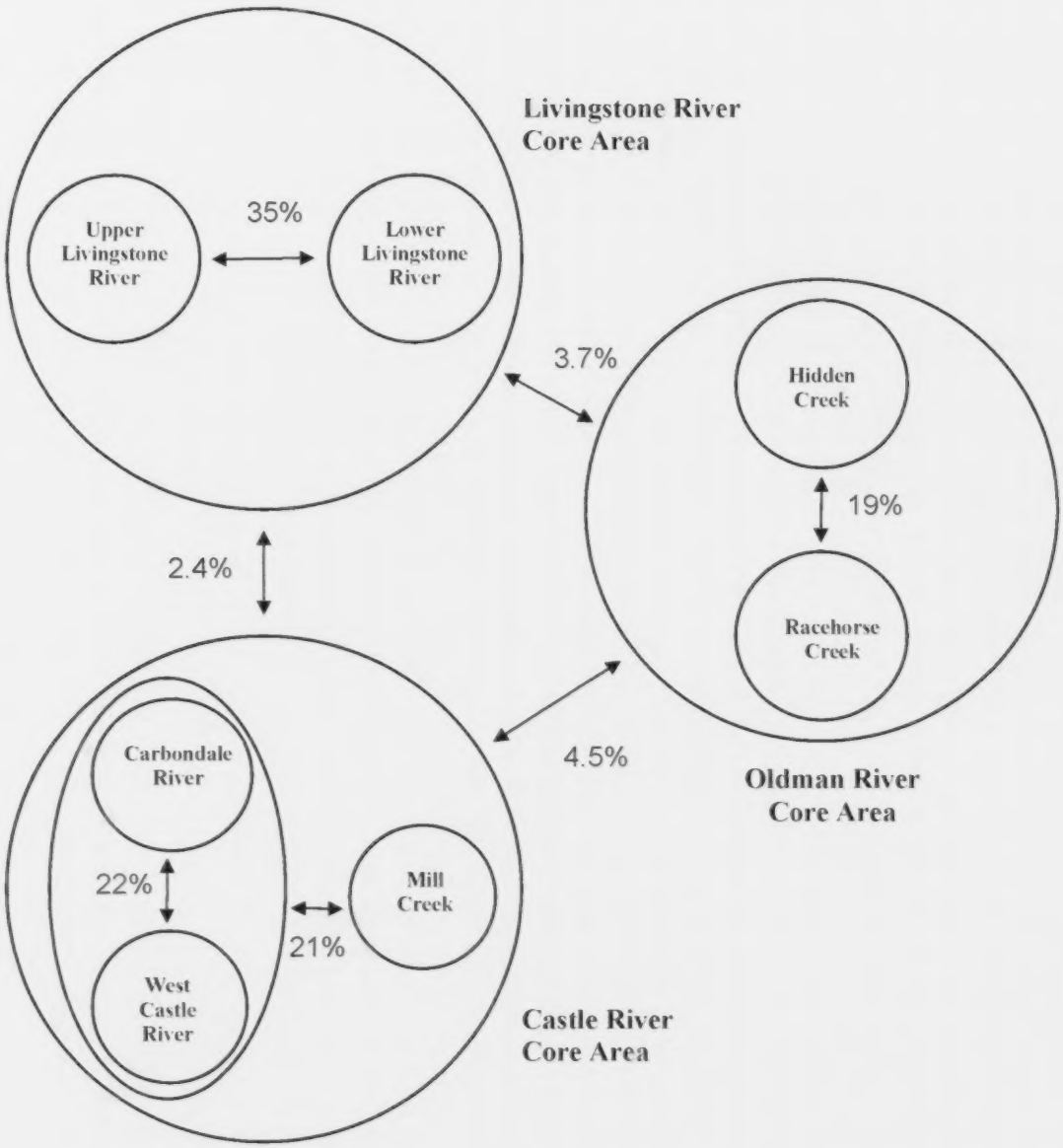


Figure 2. Bull trout metapopulation structure and admixture rates between and within three core areas (archipelagos) and seven subpopulations (local populations) in the Oldman River basin (Modified from Warnock, 2008).

2.7 Minimum Viable Population

A minimum viable population is described as an estimate of the number of individuals required for a high probability of survival of a population over a given time period. A commonly used, but somewhat arbitrary definition is: greater than 95% probability of persistence over 100 years (Traill et al. 2007). General guidelines suggest that effective population sizes of 50 and 500 reproductive individuals are essential to prevent inbreeding depression and maintain adaptive genetic variation, respectively. Rieman and Allendorf (2001) examined effective population size for bull trout and reported that it varied strongly with the effects of demographic and environmental variation in their model simulations. A cautious interpretation of their results suggests a minimum of 100 and 1000 spawning adults are required per year to prevent inbreeding depression and maintain genetic variation, respectively.

Few bull trout populations in Alberta support spawning numbers in the range of 1000 individuals. Populations with smaller numbers face greater risks and may require more aggressive management solutions to address those threats. Modelling results also indicate that populations of less than 100 spawners may be prone to extirpation if they are isolated (Rieman and McIntyre 1996). An important point in maintaining these smaller populations is the opportunity for movement and gene flow among populations within a core area (Rieman and Dunham 2000). Where subpopulations cannot support the minimum number of adult spawners, the goal should be to conserve a network of interconnected subpopulations totalling a minimum 1000 spawning adults.

3.0 POPULATION MONITORING

The Fisheries Management Branch has been monitoring bull trout within the natural range since 1968.

Trend results may be sparse due to lack of monitoring opportunities in some watersheds and/or differences in the methodology used over time within the same watershed. This lack of standardized methodology for bull trout monitoring within rivers/streams and lakes has led to complications when attempting to evaluate bull trout population abundance over time.

3.1 Long-term comparison of bull trout data

For each monitoring project, provincial fisheries biologists were asked to decide whether or not the bull trout data collected over the last decades could be compared over time. The decision and the level of confidence of that decision were taken by biologists after answering the following questions:

- Was there a change in capture efficiency of fish due to important differences in flow conditions, turbidity and/or habitat between survey years?
- Was there a change in sampling location over survey years?
- Was there a change in sampling gear and or sampling gear methodology over survey years (e.g., a significant difference in electrofishing effort on the same site over time)?
- Was there a biologically significant change in sampling dates over time?
- Are there only two survey years to compare?
- Were the less accurate measures of population trend used (e.g., population trends derived from catch per unit first pass rather than mark recapture)?

If the answer was "no" for all questions, the data were considered to be of *High* comparability over time. If the answer was "yes" to one or two questions, then the data were considered to be of *Medium* comparability. Finally, if the answer was "yes" to three or more questions, then the data were considered to be of *Low* comparability. Numerous historic monitoring projects are not reported here as the quality of the data was considered to be inadequate for comparative purposes.

3.2 Provincial Scale

Current estimates place the Alberta bull trout population at approximately 33,000 adults in 16,000 kilometres of stream and 12,000 ha in 24 lakes and reservoirs. Since the provincial regulation change to a zero harvest regulation for bull trout in 1995, a number of bull trout populations have recovered to some extent, while others have stabilized at low population levels. In a number of cases, bull trout may have decreased or even disappeared from certain streams.

3.3 Watershed Scale

Oldman River Basin

Sections of the Castle River drainage have been surveyed sporadically between 1990 and 2008 by means of electrofishing and redd counts. The results from surveys completed in the West Castle River show that the bull trout population has remained low, with some fluctuations between years, but the average population size has stayed relatively stable over the past two decades (Table 1).

Sections of the Upper Oldman drainage have been surveyed repeatedly between 1987 and 2008 by means of electrofishing and redd counts. The results from surveys completed in Hidden Creek, between 1995 and 2008, show that these spawning bull trout populations appear stable, despite low numbers, over the past few decades (Table 1).

Bow River Basin

Sections of the Elbow River drainage have been surveyed between 1979 and 2007, by means of electrofishing and redd counts. In the last decade, the bull trout population surveyed in Canyon Creek appears stable, and the spawning population in the Elbow River continues to fluctuate (Table 2). The bull trout population in Quirk Creek also appears stable, likely due in large degree to a brook trout suppression project started in 1998 (Table 3).

Sections of the Kananaskis River drainage were surveyed intermittently between 1982 and 2008 by means of electrofishing, redd counts and fish traps (Table 2). The adfluvial bull trout population of Lower Kananaskis Lake spawns in Smith-Dorrien Creek. This population has been intensively surveyed between 1991 and 2002 and has increased dramatically following the regulation change in 1992 (Table 4). Bull trout populations in Pocaterra Creek and Spotted Wolf Creek are on the verge of extirpation.

Sections of the Highwood River drainage have been surveyed sporadically between 1980 and 2009 by electrofishing, redd counts and traps. The fluvial spawning bull trout population in the Highwood River seems relatively stable while the spawning population in the Sheep River has increased substantially since the mid 1990s (Table 2).

Table 1. Summary of bull trout surveys and population trends by drainage in the Oldman River Basin.

Drainage	Waterbody	Survey years	Sampling method	Bull trout population trend*	Confidence in trend result**	References
Castle	West Castle River	Multiple years between 1990 and 2000, 2008	Electrofishing and redd surveys	Stable	Low	Fish & Wildlife Database, Gerrand and MacCulloch 1995, Gerrand and Watmough 1996, Gerrand and DeRosa 1997, Gerrand and Watmough 1999, Hurkett 2008
Upper Oldman	Hidden Creek	1995-98, 2008	Redd surveys	Stable (upper) Declining (lower)	Medium	Gerrand and MacCulloch 1995, Gerrand and Watmough 1996, Gerrand and DeRosa 1997, Gerrand and Watmough 1999, Anonymous 2008

* Stable does not imply that the population is healthy, rather that there has been no change in survey results over time.

High: Fish & Wildlife biologists have a high level of confidence in comparing the data over time (i.e. methodology and habitat conditions are highly consistent).
Medium: Biologists have a medium level of confidence in comparing the data over time (i.e. methodology and habitat conditions are partly consistent).
Low: Biologists have a low level of confidence in comparing the data over time (i.e. methodology and habitat conditions are not consistent).

For further information on the method used to assess the confidence level, please refer to the Population Monitoring Section (3.1).

Table 2. Summary of bull trout surveys and population trends by drainage in the Bow River Basin

Drainage	Waterbody	Survey years	Sampling method	Bull trout population trend*	Confidence in trend result**	References
Elbow	Canyon Creek	1996, 2005	Electrofishing	Stable	Medium	Paul & Post 1997, Fitzsimmons 2008
	Quirk Creek	Multiple years between 1997 and 2007	Electrofishing	Stable After multiple years of BKTR removal	High	Earle et al. 2008
	Elbow River	2002, 2003, 2006, 2007, 2009	Redd surveys	Fluctuating	Medium	Popowich & Eisler 2008, Fish & Wildlife Database
Kananaskis	Smith-Dorrien Creek	Multiple years between 1991 and 2002	Redd surveys and fish traps	Increasing	High (See Table 4)	Fish & Wildlife Database, Mushens et al. 2003
	Pocaterra Creek	1982, 1985, 2002, 2006	Electrofishing	Declining (marginal population)	Low	Fish & Wildlife Database, Stelfox 1983, Stelfox 1985, Fitzsimmons and Fontana. 2002
	Spotted Wolf Creek	1982, 1985, 2006, 2008	Electrofishing	Fluctuating (marginal population)	Low	Fish & Wildlife Database, Stelfox 1983, Stelfox 1985
Highwood	Highwood River	Multiple years between 1994 and 2009	Redd survey	Stable	Medium	Buchwald et al. 2006, Popowich & Eisler 2008
	Sheep River	1996, 2003, 2006, 2008	Redd survey	Increasing	Medium	Popowich & Eisler 2008, Popowich & Eisler 2009
	Flat Creek	1980, 2006	Electrofishing	Insufficient data	Low	Fish & Wildlife database, Stelfox & Ladd 1982

** Stable does not imply that the population is healthy, rather that there has been no change in survey results over time.

****High**: Fish & Wildlife biologists have a high level of confidence in comparing the data over time (i.e. methodology and habitat conditions are consistent)
Medium: Biologists have a medium level of confidence in comparing the data over time (i.e. methodology and habitat conditions are partly consistent).
Low: Biologists have a low level of confidence in comparing the data over time (i.e. methodology and habitat conditions are not consistent).
For further information on the method used to assess the confidence level, please refer to the Population Monitoring Section (3.1).

Table 3. Summary of bull trout electrofishing surveys in Quirk Creek (Bow River Basin).

Site	Year	1997	1998	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	Population trend
Upper site	Population Estimate (No. of fish/km)	N/A	21	11	13	--*	26	16	69	22	27	--*	--*	Stable (marginal population)
	95% Confidence Intervals	N/A	21-24	11-11	13-21	--*	24-32	14-??	50-??	19-885	24-29	--*	--*	—
Lower site	Population Estimate (No. of fish/km)	8	15	--*	11	--*	20	30	20	10	32	--*	--*	Stable (marginal population - may be increasing)
	95% Confidence Intervals	8-34	15-??	--*	11-49	--*	18-24	28-46	18-28	10-??	30-44	--*	--*	—

*Unable to estimate population due to low capture numbers

Table 4. Summary of bull trout fish trapping surveys in Smith-Dorrien Creek (Bow River Basin).

Year	1992	1993	1995	1996	1997	1998	1999	2000	2002	Population trend
No. of adults captured	60	155	334	649	939	1278	1152	1370	1213	Increasing

North Saskatchewan River Basin

Various sections of the Clearwater River drainage have been surveyed repeatedly within the last four decades (1968 to 2008) by means of eletrofishing and redd counts. The results in Table 5 show that:

- The fluvial and stream-resident bull trout population in Elk Creek, a tributary to the Clearwater River, was quite low in the 1970s and 1980s then increased from the 1990s onwards (Table 6).
- In the Clearwater River, the electrofishing surveys over time were not fully consistent. However, this fluvial bull trout population does seem to be surviving, in low numbers, over the past four decades.
- Electrofishing surveys on various small creeks showed that bull trout were sparse in the 1990s and remain present but low in Rocky, Cutoff and Forbidden Creeks.
- In Peppers and Seven Mile Creeks, bull trout were barely present in the 1990s and may now be extirpated. Future surveys will be needed to confirm this status.
- Other creeks used by bull trout for spawning, such as Timber Creek, Sawmill Spring and 40 Mile Spring, had low numbers of redds over the last few decades, and appear to be declining.
- The two main, known spawning areas on the Clearwater River system are 152 A&B springs. The number of redds have fluctuated in both creeks over the years, but with the mean number of redds remaining at around 20 to 25 in each.

The mainstem of the Nordegg River drainage was surveyed in 1979, 1999 and 2006 using electrofishing. These surveys suggest that the fluvial bull trout population in this river is stable, however, population estimates were not possible due to the low number of recaptures obtained (Table 5).

Pinto Lake and its outlet are part of the Cline River drainage, and were surveyed intermittently between 1987 and 2004 by means of electrofishing and fish traps. The results indicate that this population has been fluctuating over the last several decades (Table 5 and 7).

Table 5. Summary of bull trout surveys and population trends by drainage in the North Saskatchewan River Basin.

Drainage	Waterbody	Survey years	Sampling method	Bull trout population trend*	Confidence in trend result**	References
Clearwater	Elk Creek	1979, 1985, 1987, 1998, 2003, 2008	Electrofishing	Increasing	High (See Table 6)	Fish & Wildlife Database
	Clearwater River	1975,1977, 1987, 1992, 1993, 2004	Electrofishing	Insufficient recaptures for a pop estimate	Medium	Cole 1977, Allan 1980, Rhude 1988, Rhude & Rhem 1995, Rodtka 2005
	Cutoff, Forbidden & Rocky Creeks	1992, 1993, 2004	Electrofishing	Appear stable at very low levels	Low	Rhude & Rhem 1995, Rodtka 2005
	Peppers and, Seven Mile Creeks	1992, 1993, 2004	Electrofishing	Extirpated	Low	Rhude & Rhem 1995, Rodtka 2005
	Timber Creek, Sawmill, Spring and 40- Mile Spring	Multiple years between 1974 and 2004	Redd surveys	Fluctuating (marginal population)	Medium	Fish & Wildlife Database, Rodtka 2005
Nordegg	Nordegg River	1979, 1999, 2006	Electrofishing	Insufficient data for pop. estimates	Medium	Fish & Wildlife Database
Cline	Pinto Lake and outlet	1987-88, 1993-94, 2003-04	Electrofishing and fish traps	Fluctuating	High (See Table 7)	Fish & Wildlife Database

* Stable does not imply that the population is healthy, rather that there has been no change in survey results over time.
****High**: Fish & Wildlife biologists have a high level of confidence in comparing the data over time (i.e. methodology and habitat conditions are consistent)
Medium: Biologists have a medium level of confidence in comparing the data over time (i.e. methodology and habitat conditions are partly consistent).
Low: Biologists have a low level of confidence in comparing the data over time (i.e. methodology and habitat conditions are not consistent).
For further information on the method used to assess the confidence level, please refer to the Population Monitoring Section (3.1).

Table 6. Summary of bull trout electrofishing surveys in Elk Creek (North Saskatchewan River Basin).

Year	1979	1985	1987	1998	2003	2008	Population trend
Population Estimate (No. of fish/km)	Marginal*	Marginal*	Marginal*	150	209	321	Increasing
95% Confidence Intervals	N/A	N/A	N/A	110 - 276	160 - 272	261 - 402	—

* Less than 7 bull trout were recaptured. A population estimate could not be calculated. Population appears marginal.

Table 7. Summary of bull trout fish trapping surveys at the outlet to Pinto Lake (North Saskatchewan River Basin).

Year	1987-88	1993-94	2003-04	Population trend
Population Estimate	410	777	448	Fluctuating
95% Confidence Intervals	N/A	658 - 895	399 - 497	N/A

Peace/Smoky River Basin

The Kakwa River population (fluvial) has been monitored in 1997, 2000 and 2006 (Table 8) using electrofishing combined with angling. In 1995 the Kakwa River watershed was considered to be one of the last unexploited fluvial bull trout populations with intact habitat in the province. Since that time, oil and gas development and timber harvesting, primarily in the lower half of the watershed, has been rapidly advancing. Population estimates indicate the bull trout population has remained stable to date (Table 9).

Table 8. Summary of bull trout surveys and population trends, by drainage, in the Peace/Smoky River Basin.

Drainage	Waterbody	Survey years	Sampling method	Bull trout population trend	Confidence in trend result*	References
Peace/Smoky	Kakwa River	1997, 2000 , 2006	Electrofishing and angling	Stable	High (See Table 9)	Johns 2006

)

* Stable does not imply that the population is healthy, rather that there has been no change in survey results over time.

**High: Fish & Wildlife biologists have a high level of confidence in comparing the data over time (i.e. methodology and habitat conditions are consistent)

Medium: Biologists have a medium level of confidence in comparing the data over time (i.e. methodology and habitat conditions are partly consistent).

Low: Biologists have a low level of confidence in comparing the data over time (i.e. methodology and habitat conditions are not consistent).

For further information on the method used to assess the confidence level, please refer to the Population Monitoring Section (3.1).

Table 9. Summary of bull trout electrofishing/angling surveys in the Kakwa River (Peace/Smoky River Basin).

Year	1997	2000	2006	Population trend
Population Estimate	278	330	421	Stable
95% Confidence Intervals	137-418	233-427	299-544	N/A

Athabasca River Basin

The Muskeg River population (fluvial) has been monitored in 1992, 2001 and 2007 (Table 10) using electrofishing. Catch per Unit Effort (CPUE) derived from two sites in the Muskeg River indicate that the bull trout abundance is most likely decreasing over time (Table 11).

Table 10. Summary of bull trout surveys and population trends by drainage in the Athabasca River Basin.

Drainage	Waterbody	Survey years	Sampling method	Bull trout population trend	Confidence in result*	References
Athasbasca	Muskeg River	1992, 2001 and 2007	E-fishing	Decreasing	High (See Table 11)	Fish & Wildlife Database. Boag et.al. 1993

** Stable does not imply that the population is healthy, rather that there has been no change in survey results over time.
***High**: Fish & Wildlife biologists have a high level of confidence in comparing the data over time (i.e. methodology and habitat conditions are consistent)
Medium: Biologists have a medium level of confidence in comparing the data over time (i.e. methodology and habitat conditions are partly consistent).
Low: Biologists have a low level of confidence in comparing the data over time (i.e. methodology and habitat conditions are not consistent).
For further information on the method used to assess the confidence level, please refer to the Population Monitoring Section (3.1).

Table 11. Summary of bull trout electro-fishing surveys in the Muskeg River (Athabasca River Basin).

	Site	Year			Population trend
		1992	2001	2007	
CPUE (No. of fish/km)	Upper	34.88	4.02	18.76	Fluctuating (may be decreasing)
	Lower	23.42	11.03	0.86	Decreasing

3.4 Summary

In general, bull trout populations have responded to the zero harvest (catch-and-release) regulation with mixed results – a few populations have experienced substantial recovery, while the majority have fluctuated in size, with a few showing a very weak trend toward recovery. Some populations have shown limited or no evidence of recovery under the zero harvest regulation, and are suspected to continue to suffer from high levels of habitat degradation and fragmentation, competition from introduced species, and accidental as well as illegal harvest.

4.0 POPULATION STATUS AND RISK ASSESSMENT

Bull trout populations were assessed to determine population status and risk of extirpation (Sullivan 2008) using a ranking model based on a modification of the Natural Heritage Ranking process, using NatureServe Conservation Status Assessment criteria adapted for bull trout by Fredenberg et al. (2005). The model integrates current population abundance and trends, species distribution, and the severity, scope and immediacy of threats for each bull trout core area. Core areas are defined as habitat areas in watersheds that contain one or more closely linked bull trout subpopulations that form a population unit. Classifications were derived using the best available information (fisheries inventory, current fisheries knowledge and professional judgement) at the time of classification. As such, classifications must be considered to be interim rankings, that may require revision and reclassification as new information is collected. The risk assessment was reviewed and updated in the preparation of this management plan (AB Fisheries Management Branch, unpublished data). It is important to note that this exercise, to assess population status and risk, utilizes a number of criteria in addition to simple abundance and it is developed on the scale of entire core areas. This, in some cases, results in differences in the rankings produced by this exercise and the results for some of the individual monitoring sites reported in Section 3.0 above.

Fisheries Management Branch biologists classified 128 bull trout subpopulations into 51 core areas (Figures 3 to 5). These included 11 extirpated subpopulations, 3 extirpated core areas, and 1 unranked core area (Upper Bow). Bull trout core areas in watersheds shared with the three mountain national parks were noted and ranked where known. Trans-boundary populations with B.C. and Montana were ranked according to their Alberta population component. Individual core rankings are summarized in Figure 4. In summary:

- A total of 22 core areas (44%) were ranked as ***high risk*** (Figure 5a). High-risk core areas have extremely limited and/or rapidly declining numbers, range and/or habitat, making bull trout in these core areas *highly vulnerable to extirpation*.
- A total of 16 core areas (34 %) were ranked as ***at risk***. At-risk core areas have very limited and/or declining numbers, range, and/or habitat making bull trout in these core areas *vulnerable to further declines or extirpation*.
- A total of nine core areas (16 %) were ranked as ***potential risk***. Potential-risk core areas have limited and/or declining numbers, range, and/or habitat even though bull trout *may be locally abundant in some portions of the core area*.
- No core areas were ranked as ***low risk***. Low-risk core areas are where bull trout are common and widespread with intact habitat and are apparently *not vulnerable at this time*. (One core area, in Banff Park, was not ranked due to lack of data)
- Three core areas (6%) were ranked as ***extirpated***. Extirpated core areas are where bull trout no longer occupy these ranges due to combinations of harvest, habitat alteration, and/or competition from introduced species. Additionally, seven other core areas contained at least one *extirpated* subpopulation. However, due to lack of historical information, the loss of subpopulations could not be fully assessed. Additionally, some subpopulations in highly fragmented areas (e.g., middle Bow

- Short-term population trends indicate 61% of core populations are in a state of decline, while 39% are stable or increasing (Figure 5b).

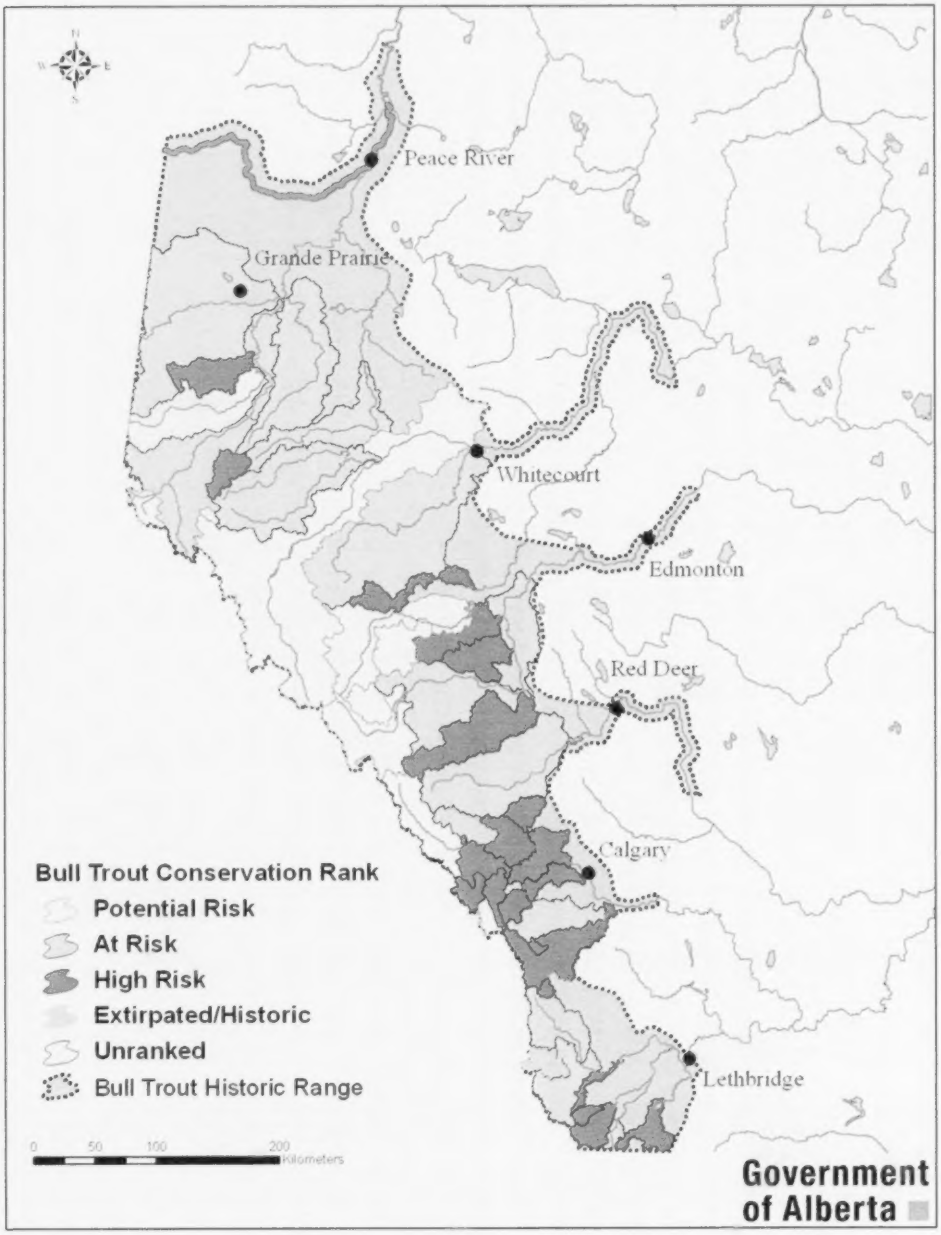
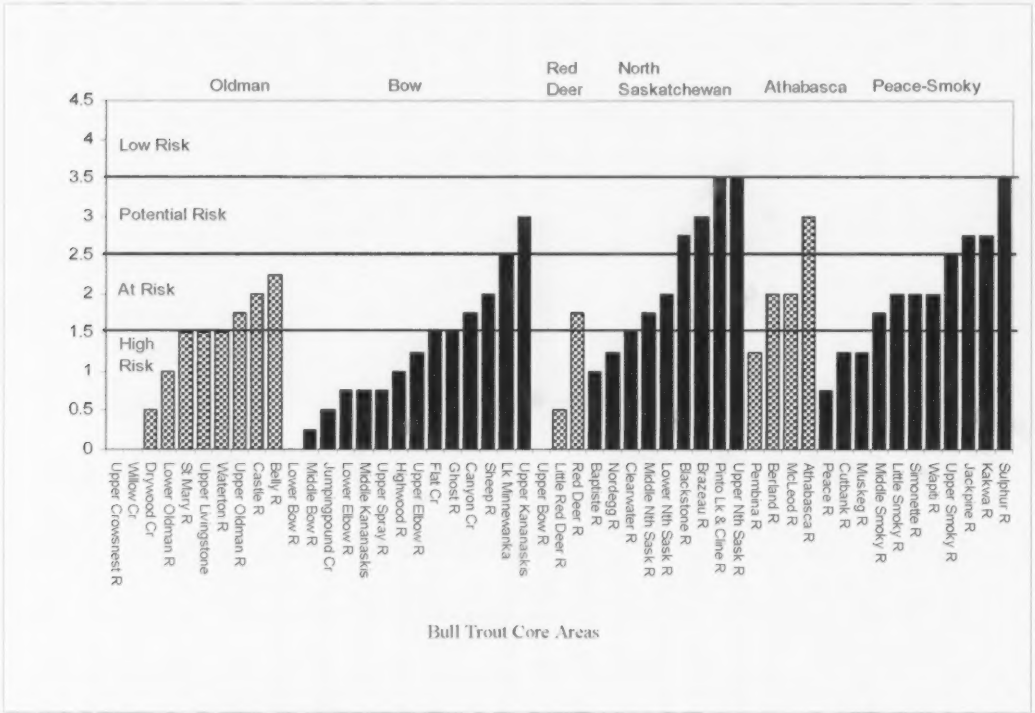


Figure 3. Spatial distribution and conservation ranking of Alberta's 51 bull trout core areas using method by Fredenberg et al. 2005.



Note: Upper Crowsnest River, Willow Creek and Lower Bow River are extirpated. The Upper Bow River is unranked.

Figure 4. Conservation ranking of Alberta's 51 bull trout core areas using method by Fredenberg et al. 2005.

From a regional perspective, most core areas in the Oldman, Bow and Red Deer basins were ranked as either ***high risk*** or ***at risk***, with the exception of one subpopulation – Lower Kananaskis Lake. These basins also had the lowest estimated number of adults in core areas (generally less than 600). Core areas in the North Saskatchewan, Athabasca and Peace-Smoky typically had higher estimated numbers of adults, occasionally exceeding 1000 individuals. While these basins had some core areas in a lower risk category (*potential risk*), the majority of core areas were still ranked as *high risk* or *at risk* largely due to expanding cumulative effects of industrial development. Recovery potential for bull trout core areas was assessed as 66% having a moderate or high recovery potential while the remainder had a low, none or unknown chance of recovery (Figure 5c).

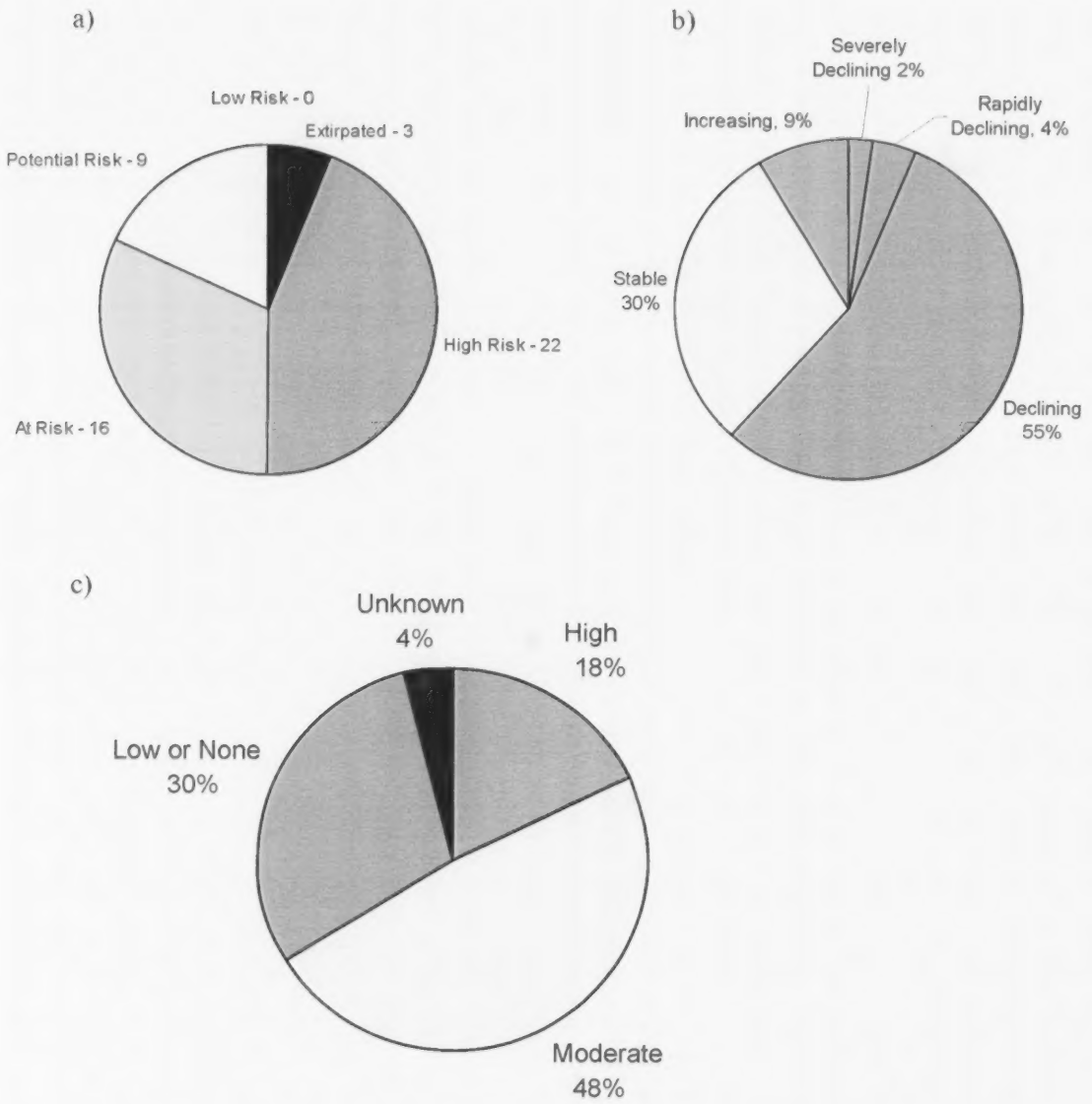


Figure 5(a) Alberta bull trout core area conservation status, 2009. Rankings based on conservation ranking protocol from Fredenberg et al. (2005). **(b)** Short term trends for Alberta bull trout core areas (n = 47). Extirpated and unranked core areas excluded (see Appendix 1. for explanation of Short-term Trend categories) **(c)** Estimated recovery potential for bull trout core areas (n = 51).

Overall the current conservation status of bull trout in Alberta is poor. Indeed, although some subwatersheds appear to be stable or increasing, their core area as a whole is declining. Also, many populations rated as "stable" are likely far below historical population levels. Hence, while few populations have been extirpated, no core areas remain healthy (i.e., low risk) and most are at considerable risk of loss. While a few populations are abundant and may be increasing, generally, angling restrictions alone have not been adequate to recover bull trout populations (Sullivan 2008).

Table 12. Bull trout core area assessment and conservation ranking. Rankings based on conservation ranking protocol from Fredenberg et al. (2005).

Core Area	Conservation Ranking	Life History	No. of Subpop[1]	Population Size[2]	Occupancy (stream km)[3]	Short-term Trend	Threats[4]	Recovery potential
Oldman River Basin (10)								
Belly River	At Risk	Fluvial Resident	1	250–1,000	4–40	Stable	Widespread, low-severity threat	Moderate
St. Mary River	High Risk	Fluvial Resident	2	250–1,000	40–200	Stable	Substantial, imminent threat	Moderate
Upper Crowsnest River	Extirpated	–	–	–	–	–	–	Unknown
Castle River & Oldman Reservoir	At Risk	Fluvial Adfluvial Resident	3	250–1,000	200–1,000	Stable	Moderate, imminent threat	Moderate
Upper Oldman River	At Risk	Fluvial Resident	4	250–1,000	40–200	Stable	Moderate, imminent threat	Moderate
Upper Livingstone River	High Risk	Resident	1	250–1,000	4–40	Stable	Moderate, imminent threat	Moderate
Lower Oldman River	High Risk	Fluvial Resident	2	50–250	40–200	Declining	Substantial, imminent threat	Low
Waterton River	High Risk	Resident	2	1–50	4–40	Declining	Localized, substantial threat	Low
Drywood Creek	High Risk	Resident	2	1–50	4–40	Declining	Substantial, imminent threat	Low
Willow Creek	Extirpated	–	–	–	–	–	–	Low
Bow River Basin (15)								
Lower Bow River	Extirpated	–	–	–	–	–	–	None

Core Area	Conservation Ranking	Life History	No. of Subpop[1]	Population Size[2]	Occupancy (stream km)[3]	Short-term Trend	Threats[4]	Recovery potential
Highwood River	High Risk	Fluvial Resident	3	50–250	40–200	Declining	Substantial, imminent threat	Moderate
Flat Creek	High Risk	Resident	1	1–50	4–40	Declining	Widespread, low-severity threat	High
Sheep River	At Risk	Fluvial Resident	3	250–1,000	40–200	Increasing	Moderate, imminent threat	High
Lower Elbow River	High Risk	Fluvial Resident	2	50–250	40–200	Rapidly Declining	Substantial, imminent threat	Moderate
Canyon Creek	At Risk	Resident	1	1–50	4–40	Stable	Widespread, low-severity threat	High
Upper Elbow River	High Risk	Resident	4	50–250	40–200	Declining	Moderate, imminent threat	Moderate
Jumpingpound Creek	High Risk	Resident Fluvial	2	1–50	4–40	Declining	Substantial, imminent threat	Low
Ghost River	High Risk	Resident Fluvial	4	250–1,000	40–200	Declining	Moderate, imminent threat	Low
Middle Bow River	High Risk	Incidental	2	1–50	4- 40	Declining	Substantial, imminent threat	Low
Middle Kananaskis R.	High Risk	Resident	1	Unranked	4–40	Severely Declining	Substantial, imminent threat	Low
Upper Kananaskis R. (Kananaskis Lakes)	Potential Risk	Adfluvial	1	1,000–2,500	40–200	Increasing	Widespread, low-severity threat	High
Upper Spray River	High Risk	Resident	3	1–50	4–40	Declining	Moderate, imminent threat	Low
Lake Minnewanka	At Risk	Resident	2	50–250	4–40	Declining	Slightly threatened	Moderate
Upper Bow River	Unranked	Resident Fluvial?	–	Unranked	–	–	–	Unknown
Red Deer River Basin (2)								
Red Deer River	At Risk	Fluvial Resident	4	250–1,000	200–1,000	Declining	Moderate, imminent threat	Moderate

Core Area	Conservation Ranking	Life History	No. of Subpop[1]	Population Size[2]	Occupancy (stream km)[3]	Short-term Trend	Threats[4]	Recovery potential
Little Red Deer River	High Risk	Resident	1	1–50	4–40	Declining	Substantial, imminent threat	Low
North Saskatchewan River Basin (9)								
Brazeau River	Potential Risk	Fluvial Resident	4	1,000–2,500	200–1,000	Stable	Widespread, low-severity threat	Moderate
Blackstone River	Potential Risk	Fluvial Resident	4	250–1,000	200–1,000	Stable	Widespread, low-severity threat	Moderate
Nordegg River	High Risk	Fluvial	2	50–250	40–200	Declining	Moderate, imminent threat	Low
Baptiste River	High Risk	Resident	1	1–50	40–200	Declining	Moderate, imminent threat	Low
Upper North Saskatchewan River	Potential Risk	Fluvial	1	250–1,000	40–200	Increasing	Slightly threatened	Moderate
Pinto Lake & Cline River	Potential Risk	Adfluvial Fluvial	2	1,000–2,500	40–200	Stable	Slightly threatened	Moderate
Middle North Saskatchewan River	At Risk	Fluvial	1	250–1,000	40–200	Stable	Moderate, imminent threat	Low
Lower North Saskatchewan	At Risk	Fluvial	1	50–250	40–200	Stable	Moderate, non-imminent threat	Low
Clearwater River	High Risk	Fluvial Resident	3	250–1,000	40–200	Declining	Moderate, imminent threat	Moderate
Athabasca River Basin (4)								
Pembina River	High Risk	Fluvial Resident	2	50–250	40–200	Declining	Substantial, imminent threat	Moderate
McLeod River	At Risk	Fluvial Resident	3	1,000–2,500	1,000–5,000	Declining	Substantial, imminent threat	Moderate
Athabasca River	Potential Risk	Fluvial	3	1,000–2,500	1,000–5,000	Declining	Localized, substantial threat	Moderate
Berland River	At Risk	Fluvial	2	250–1,000	1,000–5,000	Declining	Moderate, imminent threat	Moderate
Peace-Smoky River Basin (11)								

Core Area	Conservation Ranking	Life History	No. of Subpop[1]	Population Size[2]	Occupancy (stream km)[3]	Short-term Trend	Threats[4]	Recovery potential
Little Smoky River	At Risk	Fluvial	1	250–1,000	200–1,000	Stable	Moderate, imminent threat	Moderate
Upper Smoky River	At Risk	Fluvial	6	2,500–10,000	1,000–5,000	Stable	Moderate, imminent threat	High
Middle Smoky River	At Risk	Fluvial	1	250–1,000	200–1,000	Declining	Moderate, imminent threat	Moderate
Sulphur River	Potential Risk	Resident	1	250–1,000	40–200	Increasing	Slightly threatened	High
Jackpine River	Potential Risk	Resident	1	250–1,000	200–1,000	Stable	Widespread, low-severity threat	High
Muskeg River	High Risk	Resident	1	50–250	200–1,000	Declining	Substantial, imminent threat	Moderate
Wapiti River	At Risk	Fluvial Resident	5	1,000–2,500	200–1,000	Declining	Moderate, imminent threat	Moderate
Peace River	High Risk	Fluvial Resident	1	1–50	40–200	Declining	Substantial, imminent threat	Low
Cutbank River	High Risk	Fluvial Resident	2	50–250	200–1,000	Rapidly Declining	Moderate, imminent threat	Moderate
Kakwa River	Potential Risk	Fluvial Resident	11	2,500–10,000	200–1,000	Declining	Localized, substantial threat	High
Simonette River	At Risk	Fluvial	3	1,000–2,500	200–1,000	Declining	Moderate, imminent threat	High

1. Number of known subpopulations in core area, extirpated subpopulations excluded.
2. Estimated number of mature adults (within category range).
3. Estimated number of occupied stream kilometres (within category range).
4. Threats assessment considered the scope, severity and immediacy of threats to habitat, from exploitation and fish community (introduced competitive species).

5.0 LIMITING FACTORS

Bull trout require highly connected, diverse habitats with complex forms of cover and clean cold water. They are sensitive to degraded water and habitat conditions and are considered an indicator of ecosystem health. Factors that influence bull trout distribution and abundance include water temperature, open migratory corridors, substrate composition, instream and overhead cover, habitat complexity as well as the presence of competitive species and angling mortality.

5.1 Habitat Fragmentation

Bull trout are a highly migratory fish that require habitat connectivity – unobstructed passage throughout watersheds to link key spawning, rearing and overwintering habitats for all life stages. Habitat connectivity is also important in linking populations, which facilitates gene flow and supports the re-establishment of depleted populations. Habitat fragmentation results from the creation of barriers to migration. Barriers can be caused by: 1) elevated or undersized culverts; 2) dams not equipped with fish passage facilities; 3) water diversion canals or water withdrawal practices that entrain fish or reduce stream flow; and 4) land-use activities that degrade habitat conditions, limiting or excluding use. The effects of fragmented watersheds on bull trout populations vary depending on severity and scope. In general, fragmentation results in the alienation of stream reaches, range contractions and population declines. Where populations become isolated, they are at risk of genetic depression (reduced genetic diversity) and increased recovery times after population setbacks, leading to reduced population viability (Thomas et al. 2001, Warnock 2008). Populations that become isolated are at greater risk of extirpation.

5.1.1 Culverts

Culverts create barriers to upstream movements when the streambed below the downstream end of the structure erodes – a function of culvert age and streambed slope – leaving an elevated (hanging or perched) outfall that fish can not enter. Elevated culverts can also occur through improper installation, the use of undersized culverts, or inadequate armouring of the downstream bed. Culverts can also create velocity barriers, increase sedimentation and interfere with the natural transport and recruitment of large woody debris – a key instream habitat element. The scope of these problems has increased along with the expanding network of roads in Alberta and is a provincial-level issue. Several audits of stream crossing structures in northwestern Alberta watersheds rated approximately half of assessed culverts as being potential barriers to fish passage (Park et al. 2008; Johns and Ernst 2007; Scrimgeour et al. 2003).

The problems that arise from using culverts as crossing structures on fish-bearing streams have been identified since the 1970s. Formal recommendations and guidelines centering on the use of structures that retain the natural streambed to ensure fish passage (bridges or open-bottom culverts) have been made on a regular basis since that time. Some progress has been made to resolve stream crossing issues and remediate problem culverts, including efforts by a cross-ministry task force and industry partners. However, culvert-related habitat fragmentation continues to be a pressing and correctable issue.

Appropriate stream-crossing structures for fish-bearing streams retain the natural streambed through the use of open-bottom structures (i.e., bridges) that do not constrain the active channel (bank full width). Closed-bottomed culverts should be reserved for non-fish bearing streams and ditch crossings. Replacing hanging culverts with bridges to restore fish passage has resulted in rapid recolonization by bull trout in formerly alienated stream reaches (Shrimpton et al. 2008). A comprehensive fish passage restoration program that includes replacing failed culverts is required for the eastern slopes to restore lost habitat connectivity critical to bull trout and other native species.

5.1.2 Dams

Dams that are not equipped with fish passage facilities fragment river basins by creating barriers to upstream fish passage. Additionally, dams can become a mortality sink for bull trout populations through direct mortality where fish are not prevented from passing through turbines (entrainment). Fragmented river reaches can become functionally extirpated (bull trout individuals may still be present from upstream populations) if there are no spawning/rearing habitats downstream of the dam.

Large dams were constructed from 1911 to 1991 and were designed without fish passage facilities. However, low head dams (weirs) are generally equipped with fish ladders, although these can have siltation or design problems that require regular maintenance or upgrading. The Bow River watershed is the most fragmented basin in Alberta with 11 dams and two weirs. Dams are also located in the Oldman River basin (three dams, two weirs), Red Deer River (one dam), North Saskatchewan River (two dams) and the Peace River (Alberta reach – one dam approved, B.C. reach - two dams and one approved). The Athabasca and Smoky rivers are the only large rivers in Alberta that are not dammed on the mainstem.

Innovative fish passage designs should be incorporated into any new dam project in the province. The approved Peace River hydroelectric dam at Dunvegan will allow for both upstream and downstream fish movement (Northwest Hydraulics et al. 2005), although free passage within the proposed fish ladders, as well as mortality through the turbines remain issues of concern.. The WID weir in Calgary is also currently being replaced with a series of stepped pool-and-drop structures for recreation purposes, that will also provide enhanced fish passage. However, many older facilities lack fish passage and remain an obstacle to bull trout recovery. These facilities should be upgraded to provide fish passage in the future, if it is deemed that providing fish passage would help the bull trout population recover.

5.1.3 Irrigation Canals

The diversion of surface waters into irrigation canals fragments habitat by 1) reducing instream flows which can result in water temperatures that exceed bull trout tolerance, and 2) entraining migrating bull trout that travel into irrigation canals below water control structures within the canal system. Entrainment can be significant; loss of bull trout into an irrigation canal on the Belly River accounted for 15 - 20% of annual mortality (Clayton 2001). The irrigation district subsequently equipped that canal's headworks

with a fish diversion screen. Canal headworks that are not equipped with fish diversion screens can become a mortality sink for bull trout and other fish species. Water diversion canals in bull trout habitat are located in southern Alberta, including the Oldman, Belly, St. Mary, Highwood and Bow rivers.

5.2 Stream Flow Regime

The *Alberta Water for Life* strategy reaffirms Alberta's goal to maintain healthy aquatic ecosystems by managing water and allocations to sustain aquatic ecosystems and ensure that their contribution to Alberta's natural capital and quality of life are maintained (Alberta Environment 2003). The health of stream and river ecosystems depends on the natural flow regime (Alberta Environment 2008).

5.2.1 Peak Flow Intensity

In fluvial ecosystems peak flows (flood pulses) are a governing dynamic in determining channel morphology, sediment transport, instream habitat characteristics and are one of the fundamental aquatic community organizers. Peak flows occur as a result of spring runoff and storm events. While peak flows are an important component of healthy fluvial ecosystems, increasing their intensity can impact bull trout habitats by destabilizing channels, scouring gravel beds, accelerating the erosion of banks and riparian areas, causing stream widening, dislodging stable large woody debris, and displacing fish (particularly early life stages). Increased peak flow intensity is a result of increased water yield, which is related to the proportion of a catchment basin that is disturbed, the ecological region and forest harvest practices being employed (Ripley et al. 2005).

Watershed disturbance thresholds are currently under examination in the Province, as part of improved watershed analysis procedures for forest management planning in Alberta. Additionally, a more transparent monitoring and tracking system of cumulative disturbance and hydrologic recovery, from all landuse activities in watersheds, is required to more effectively manage water yield to avoid impacts on bull trout populations..

Bull trout rely on a network of high quality habitats in mainstem and tributary streams. Relative to large streams, small streams are more easily impacted by the effects of peak flow changes, which also occur more readily on small streams, since a moderate amount of development can impact a large portion of a small watershed. If all life stages of bull trout are to be considered, watershed analysis procedures need to be conducted for 3rd order watersheds, as well as larger ones.

5.2.2 Roads

Roads modify natural drainage networks by intersecting surface and subsurface water flow, capturing and concentrating the flow in ditches and increasing the rate of delivery of water and sediment to stream channels. This situation impacts stream-flow regimes and fish habitat by intensifying the magnitude and frequency of high flow and siltation events. The magnitude of the hydrologic impact is influenced by road density, road location (hillside vs. valley bottom), watershed characteristics (topography, soils,

geology) and watershed size. As with upland disturbance, smaller tributary watersheds are more easily impacted by road development.

Over the past decades there has been a proliferation of resource access road networks developed in the eastern slopes. The density of road networks in a watershed is becoming an increasingly important measure of watershed impact and impact on bull trout populations. For example, Ripley et al. 2005 examined relations between cumulative levels of forest harvesting and density of road networks on the occurrence and abundance of bull trout in the Kakwa River Basin, Alberta. Logistic regression models showed that the probability of bull trout occurrence decreased with an increase in the percentage of sub-basin harvested and road density (figure 6).

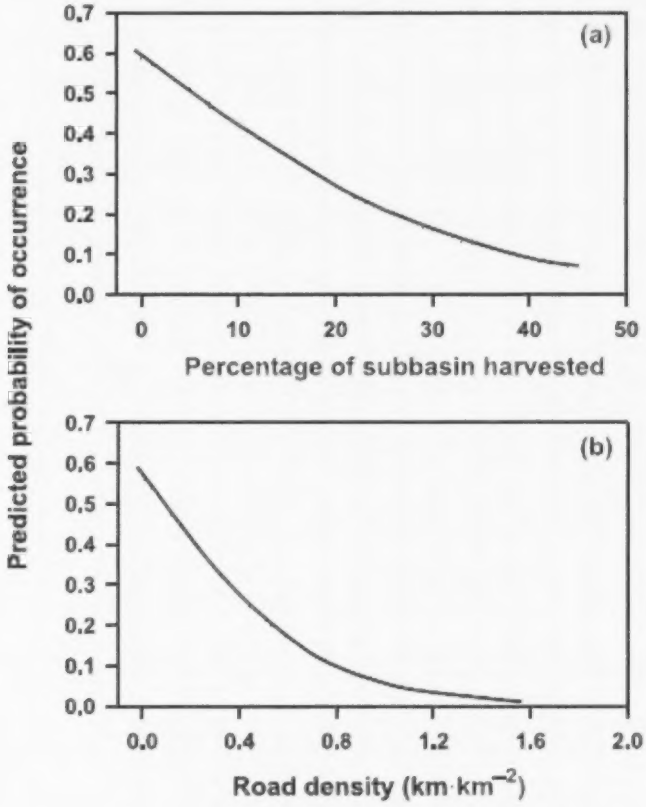


Figure 6. Logistic regression models of the predicted probability of bull trout (*Salvelinus confluentus*) occurrence. (a) Percentage of the sub-basin subjected to forest harvesting and (b) Density of roads in the Kakwa River basin (Extracted from Ripley et al. 2005).

There has been some limited success in recent years in several pilot areas in Alberta, in reducing road density through Integrated Land Management (ILM) that coordinates access management planning between the timber and oil/gas industries. However, many forest roads are left open following completion of harvest in order to provide access for silviculture activities. This can prolong the period of use and the impact created by roads that are classed as temporary. There is much room for improvement in the area of

road abandonment and reclamation. Road density levels in bull trout watersheds need to be determined and density threshold limits observed in managing access if impacts on bull trout populations are to be reduced and recovery is to be achieved.

5.2.3 Dams

The operation of hydroelectric plants, seasonal reservoir filling, and water diversions are the main contributing factors to altering the natural flow regimes of large rivers and the productive littoral zone in reservoirs. Seasonal drawdown and reservoir filling not only destroy the productive littoral zone, reducing food supply for bull trout, but also attenuate spring peak flows below the dam, resulting in changes to river and floodplain habitats. Water diversions reduce summer flows, decreasing physical and thermally suitable habitats for bull trout. The operation of hydro-peaking plants create rapid and frequent (i.e., daily) changes to river flow. The sudden changes in depth and velocity displaces fish and disturb spawning activities, while rapid flow reductions and drying of shallow water habitats adversely affects aquatic insect production and can strand small fish and lead to desiccation and loss of incubating bull trout eggs.

The impacts of dams and diversions on bull trout could be mitigated through (a) reducing or eliminating annual reservoir drawdown, (b) developing operating standards that regulate flow to more closely mimic natural flow regimes, and (c) establishing minimum or base flows.

5.2.4 Groundwater

Groundwater influence at spawning areas plays an important role in the success of bull trout egg incubation by providing a constant flow of water that moderates temperatures and protects eggs against freezing or desiccation during low winter-flow periods. Careful management and conservation of groundwater resources affecting bull trout spawning areas is required.

The impacts of land-use practices on groundwater resources – through the reduction of groundwater quality, quantity or the disruption of recharge areas – require further research in Alberta.

5.3 Sedimentation

Sedimentation can reduce the biological productivity of aquatic ecosystems, damage habitats, and can have both sublethal and lethal effects on fish. Sublethal effects are related to increasing the stress that fish experience, disrupting their feeding, growth, movements and increasing susceptibility to disease (Birtwell 2000). Lethal effects include direct mortality of fish, particularly young-of-year, and reducing survival of incubating eggs through entombment. Loose substrate (i.e., low embeddedness) is essential as cover for bull trout fry and invertebrate production. Sedimentation cements or buries gravel/cobble substrate, reducing the carrying capacity of the stream.

Road surfaces, ditch clearing, road side-cuts and crossing structures can all contribute to increased stream sedimentation, with most sediment delivered at stream crossings. Audits of stream crossing structures in the Kakwa River watershed indicated 72% of crossings were rated as a very high sediment delivery hazard (Johns and Ernst 2007). A more recent source of sedimentation is the result of OHV trail crossings and traffic along and within streambeds. In the most extreme cases, streambeds are used as travel routes. This activity erodes banks and disturbs the streambed, causing elevated levels of suspended sediment, often at times of the year when sediment transport is normally low and bull trout eggs are in the gravel (Fontana 2003, Eisler 2003).

5.4 Stream temperature

As cold-water specialists, bull trout are susceptible to watershed disturbances that contribute to increased water temperatures in streams, and are vulnerable to the effects of a warming climate. Rising stream-temperature regimes reduce thermally suitable habitats, leading to reduced abundance of bull trout and range contractions. Brook and brown trout have higher temperature tolerances than bull trout and the risk of invasion of bull trout range by these introduced species may increase with rising water temperatures (McCleary and Hassan 2008).

Watershed disturbances that can increase water temperatures include forest harvesting, road development and grazing that removes riparian vegetation. Maintaining intact riparian forest with wind-firm buffers is a key conservation management practice for bull trout and other aquatic species. Water diversions and extractions have a direct effect on water temperatures by reducing instream flows. Maintaining sufficient instream flows to prevent abnormal rises in water temperature are required to maintain thermally suitable habitats.

The effects of climate change pose significant risk to bull trout and other cold-water species. In Alberta, climate change is anticipated to result in less precipitation falling as snow and increasing midwinter melts, resulting in reduced mountain snowpacks and diminished glaciers supplying little more than half of the water that they currently do (Schindler and Donahue 2006). The number of days that winter snow has remained on the ground and the maximum depths of snowpacks have already declined significantly in much of Alberta since the mid-20th century. Combined with earlier spring melting, higher evaporation rates and warmer summer temperatures, rivers and streams will have longer summer low-water periods and higher temperatures. These changes may result in further bull trout range contractions and population declines. Increasing stream temperatures can lead to further fragmentation of the metapopulation, by confining subpopulations of fish to the higher elevation headwater portions of watersheds where suitable water temperatures still exist. Thermal isolation of populations could lead to reduced gene flow within the metapopulation and could prevent re-establishment of extirpated populations. Protecting the thermal conditions of streams all the way to their confluences with mainstems is particularly critical because these are the points that individuals must pass in order to move into other segments of the watershed. Managing bull trout as robust populations in otherwise healthy and secure habitats will be critical to reduce the threats to population persistence in a warming climate.

5.5 Cumulative Impacts

The cumulative impacts of land-use disturbance resulting from forest harvesting, oil and gas development and road networks on the occurrence and abundance of bull trout were evaluated in north western Alberta watersheds. In two study watersheds, cumulative effects of development impaired or possibly impaired 76% of test sites. Impaired test sites supported lower densities of bull trout compared to appropriate reference sites (Scrimgeour et al. 2003). In another study, logistic regression models in the Kakwa watershed predicted that forest harvesting over the next 20 years will result in the local extirpation of bull trout in 24% to 43% of stream reaches that currently support bull trout (Ripley et al. 2005).

The potential cumulative impacts of land and water disturbances on fish and their habitat are not fully understood and yet they are clearly visible on the landscape (Figure 7). As well, currently there is no direct management of cumulative impacts on streams and rivers in the province. This is a crucial area that requires more resolve to quantify impacts and thresholds, and find viable management options to protect fish and their habitat.

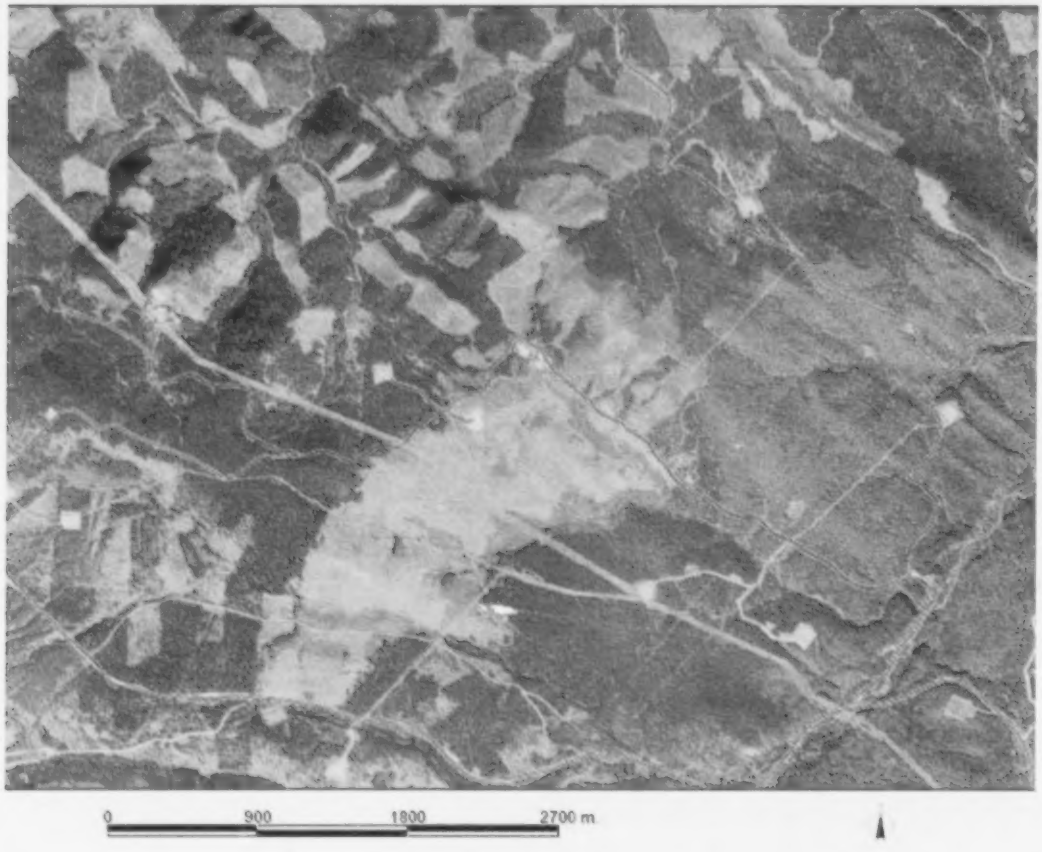


Figure 7. A recent satellite image showing cumulative impacts on Alberta's landscape (approximately 20 km NE of Nordegg, Alberta) from multiple activities such as clear cutting, access development and oil/gas activities.

5.6 Introduced Species

Past introductions of competitive non-native species (i.e., brook trout, brown trout) and native species (i.e., lake trout) have been a contributing factor to bull trout population declines, range contraction, and the extirpation of subpopulations in Alberta. These species have naturalized and out-competed bull trout in many lakes, streams and rivers formerly occupied by bull trout, including waters in the Alberta mountain national parks. Bull trout may still be present, but are often relegated to a minor component of the fish community in many systems that are now occupied by introduced competitive species. The presence of introduced competitive species continues to jeopardize bull trout recovery.

Lake trout introductions have followed a pattern of establishment and dispersal to other lakes, with the decline or elimination of adfluvial bull trout populations occurring over a period of decades. In Banff National Park, lake trout were introduced in 1964 to Bow Lake and by 1984 bull trout had disappeared. The lake trout dispersed to Hector Lake during the 1970s and bull trout were no longer present by 1992 (Donald and Alger 1993). Lake trout were introduced to Spray Lakes Reservoir in 1951 and by 1973 bull trout had disappeared (Donald and Stelfox 1997). In Abraham Reservoir, on the North Saskatchewan River, gill netting surveys in 1973 found 100% bull trout and no lake trout. Gill netting surveys conducted in 2007 found a ratio of 3.5% bull trout to 96.5% lake trout (Alberta Fisheries Management, in prep.).

The impact of brown trout introductions on bull trout populations is not well documented. However, in combination with brook trout, habitat disruptions or other stressors, brown trout may have been a contributing factor in the decline or loss of some bull trout populations. Examples include Barrier Reservoir/Kananaskis River (Rasheed 1997), the Canmore reach of the Bow River (Bow Falls – Seebe Dam) (Rawson 1948) and in southwestern Alberta (Fitch 1997). However, bull trout may be recovering in Elk Creek (Clearwater watershed) despite continued competition with brown and brook trout since the regulation change to zero harvest of bull trout in 1995. Surveys in 1985 and 1987 found 0.42 and 0.10 bull trout per 100m, respectively, while population surveys in 2003 and 2008 found 15.8 and 22 bull trout per 100m, respectively, in the same section (Alberta Fish & Wildlife database).

Brook trout are the most widespread of the introduced competitors occurring in many streams, rivers and lakes in the foothills and mountains. Brook trout compete vigorously and have seriously compromised bull trout populations in Alberta. Brook trout are capable of establishing relatively dense populations in small streams, resulting in the displacement of bull trout.

Brook trout were introduced to the Elbow River watershed in 1940 and by 1978 had begun colonizing the lower reach of Quirk Creek, compromising the stream-resident populations of bull and cutthroat trout. By 1995, brook trout had spread throughout the creek and had become the dominant fish species, comprising 92% of the fish population

(Stelfox et al. 2004). In 1998, a brook trout suppression project was initiated using targeted angling and electrofishing removal of brook trout to try and stimulate recovery of bull trout and cutthroat trout populations. The results of the project have been mixed (Table 13).

Table 13. Quirk Creek bull, cutthroat and brook trout composition (brook trout suppression project initiated in 1998; Earle et al. 2010).

	1978	1995	2000	2002	2004	2007	2009
Lower Site (N)	208	79	355	186	161	210	139
% BLTR	8	3	1	2	9	7	3
% CTTR	57	5	16	12	48	40	60
% BKTR	35	92	83	86	43	53	37
Upper Site (N)	132	N/A	416	122	247	239	94
% BLTR	54	N/A	1	3	2	4	1
% CTTR	46	N/A	21	6	32	45	66
% BKTR	0	N/A	78	91	66	51	33

BLTR – bull trout; CTTR- cutthroat trout; BKTR – brook trout

The mechanisms that regulate the invasive success of introduced species or the resistance of bull trout are not fully understood. Brook and brown trout have higher feeding and aggression rates than bull trout, particularly at warmer temperatures. The relatively slow growth, late maturity and variable spawning frequency of bull trout may be competitive disadvantages in the presence of non-native species. Bull trout appear to be able to resist invasions of brook trout in optimal conditions – streams with cold water temperatures, high levels of habitat complexity, good connectivity and no harvest. The complex interactions between competing species and habitats can result in populations of bull, brook and brown trout aligning on altitudinal or temperature gradients in watersheds, with bull trout being limited to the colder stream reaches.

Fluvial/adfluvial populations of bull trout may be more resistant to brook trout than stream-resident populations. Mill Creek in the Castle River watershed contains brook trout and a population of large-bodied fluvial/adfluvial migrant bull trout that has resisted brook trout invasion, both ecologically and genetically (Alberta Fish and Wildlife). Factors that have led to successful resistance are being investigated and may include:

- Morphological differences – the large size of migrant spawners may contribute to a high degree of successful spawning, and prevent interloping brook trout from fertilizing bull trout eggs.
- Differences in spawning times between resident brook trout and migrant bull trout, which would reduce the chances of ripe brook trout being present when bull trout are depositing their eggs.
- Bull trout juveniles avoiding direct competition with brook trout by moving out of the stream to rear elsewhere.

5.6.1 Hybridization

Genetic analysis of the Quirk Creek population confirmed hybridization between the stream-resident population of bull trout and brook trout. Hybrids generally comprised <4% of the catch, ranging from 0.5 – 12 % during different sampling events. It was noted that hybrids occasionally outnumbered bull trout. Hybrids are generally believed to be sterile; however, some hybrids were determined to be F2 backcrosses – indicating that some individuals are fertile (Earle et al. 2007). On a provincial scale, there has been limited genetic collection and analysis for hybrids, partially due to the difficulty in field identification of hybrids, hence the full extent of hybridization is unknown.

New standardized stocking policies for non-native species are in place for government stocking programs and commercial aquaculture facilities that greatly reduce the risk of fish escapement. While the risk of new introductions is low, the amount of potential restoration work in bull trout range is immense. Restoration programs in Alberta and other jurisdictions have shown that, while possible, removal of introduced competitors is a difficult, complex, long-term process. Removing all populations of introduced competitors is not feasible or necessarily desirable, but removal of some introduced competitors may be considered as a component of a comprehensive recovery program for subpopulations that are at immediate risk of extirpation. However, further research and development of removal strategies is required. Restocking of bull trout in combination with non-native species removal may be required to recover bull trout populations in some cases. However, due to our limited knowledge of genetics of Alberta bull trout there is need for caution in moving stocks between watersheds in order to prevent possible genetic contamination of unique strains. Currently, Alberta is following a policy of transfers only within subpopulations for supplementary stockings. In cases of completely extirpated subpopulations, transfers from the next closest stock in the watershed would be considered.

5.7 Natural and Angling Mortality

Quantitative information on the abundance of bull trout over long time periods is very limited in Alberta, making it difficult to assess the extent of population declines and recovery. Broad natural fluctuations in the abundance of juveniles have been documented in Eunice Creek, AB. In this relatively undisturbed watershed, where angling had been closed for over 20 years, abundance of fish in the stream fluctuated by 2 orders of magnitude in 15 years (Hunt et al. 1997). This natural variation in juvenile abundance was attributed to competition and cannibalistic behaviour (Paul et al. 2000). This tendency for wide natural fluctuations in bull trout populations can make it difficult to clearly determine trends in populations. Post et al. (2003) used an instantaneous natural mortality rate for bull trout between the ages of 0 to 15 years of 0.20, and indicated this was in accord with observed mortality of mature bull trout in Lower Kananaskis Lake when no angling harvest was permitted (Mushens et al. 2003). However, analysis of more recent angling (2003) and gillnetting (2011) data suggests that the natural mortality rate for mature bull trout in Lower Kananaskis Lake is actually considerably lower than 20%, since the total mortality rate determined from those later studies is approximately 14% (J. Stelfox 2012, pers. comm.).

Bull trout are very susceptible to exploitation. Prior to the implementation of the province-wide zero harvest regulation in 1995, bull trout were overexploited throughout the eastern slopes in accessible watersheds. This was due to their vulnerability to angling, particularly when bait was used, and their reputation as unwanted predators or 'trash' fish. Where recovery of bull trout populations has occurred, it is largely due to angling regulation changes and related management activities including: (1) zero harvest limit, (2) bait bans, (3) seasonal and permanent angling closures in key spawning, staging and overwintering areas, (4) public awareness and education efforts to reduce unintentional harvest (fish misidentification), and (5) enforcement efforts to reduce illegal harvest. In Lower Kananaskis Lake the annual mortality rate of tagged, mature bull trout went from an estimated 48% to only 5% after the implementation of zero harvest regulations (Stelfox 1997).

Bull trout population and fisheries model (BULLSIM v2.0) simulations have demonstrated that bull trout populations can not be sustained without restrictive angling regulations given realistic estimates of fishing effort, catch-and-release mortality, and illegal harvest (Post et al. 2003). There are only a few populations in the province where adequate data exist to consider permitting a small amount of bull trout harvest, e.g., Kananaskis Lakes. Post et al. (2003) caution that the interaction between regulations, fishing quality and angler behaviour may render regulations ineffective in sustaining native fish stocks near high concentrations of potential anglers. It is concluded that adfluvial bull trout can produce trophy fisheries, but only under a very narrow range of angling effort. Any potential harvest would require very restrictive regulations (i.e., draw/tag system) to limit harvest and hooking mortality from increased angling effort and would require substantial public and aboriginal consultation in the planning stages.

Education and enforcement efforts have likely reduced angler noncompliance. However illegal harvest, particularly in remote areas, and fish misidentification are persistent problems that require vigilant management efforts. A study conducted 10 years after the implementation of the province-wide zero harvest regulation revealed that roughly half of the anglers surveyed were unable to correctly identify bull trout (Alberta Fish and Wildlife, unpublished report). Exacerbating these problems, rapidly expanding resource development in the eastern slopes has resulted in a proliferation of new roads and trails providing unprecedented access to stream reaches that were formerly remote. Resource development creates high-risk environments for bull trout due to the cumulative effects of degraded habitat conditions combined with increased angler access.

6.0 RECENT CONSERVATION AND MANAGEMENT EFFORTS

Alberta's Bull Trout Management and Recovery Plan (1994) and the Endangered Species Conservation Committee's Initial Conservation Action Statement (2002) recommended a suite of management and research objectives and strategies to achieve bull trout recovery. Elements included harvest management, public education, enforcement, and research and inventory to define bull trout population status, ecology, habitat requirements and the impacts of industrial activities and non-native species. The recommendations from those two documents have largely guided bull trout management and recovery efforts in Alberta over the past 15 years.

Significant progress has been made in many areas, including early successes in harvest management, public education, baseline inventories, defining bull trout ecology and habitat impacts. Monitoring efforts have progressed, but have been challenged by lack of provincial coordination, shifting management priorities and fluctuating budgets. Survey design has been revised to increase precision and predictive capability, but this has often resulted in new datasets that are not comparable to older ones, reducing the ability to precisely determine quantitative changes in bull trout abundance over the past 20 years.

Resolving habitat issues and maintaining unimpaired ecosystems are some of the most complex challenges to conserving bull trout. The conversion of the eastern slopes watersheds from a largely natural condition to one reflecting an advancing state of timber, oil and gas, access and mining development is occurring at a rapid pace and on a regional scale. While several key ecosystem management initiatives have been introduced, their success hinges upon complex multi-agency coordination and cooperation, and full participation from all industry sectors.

Key actions that have been taken since 1994 to pursue bull trout management and recovery objectives are listed in Table 14. Many of these actions are ongoing, long-term commitments to bull trout management and recovery, and are further identified in the management actions of this plan.

Table 14. Overview of management and recovery actions undertaken from Alberta's Bull Trout Management and Recovery Plan, 1994 and the Alberta Endangered Species Conservation Committee (ESCC) – Conservation Action Statement, 2002.

HARVEST MANAGEMENT	
BLTR Plan (1) Implement a province-wide zero catch limit (catch and release fishing) for bull trout.	A province-wide bull trout zero harvest (catch-and-release only) regulation was implemented in 1995 and remains in effect.
ESCC Conservation Action Statement (1) Assess the efficacy of the current zero bag limit in maintaining and restoring populations.	The results of monitoring suggest a range of population responses – from recovery, to no apparent change, to continued decline. Where population recoveries have occurred, they are largely due to the zero harvest regulation combined with relatively secure habitats. Populations that have stabilized at low numbers, or are considered to be in continued decline, are hampered by the cumulative effects of industrial land use (proliferation of roads, access, logging, oil & gas activity), competition from non-native fish species and illegal harvest.
BLTR Plan (1.c) Determine the carrying capacity of various habitats for bull trout; the conservation needs to perpetuate bull trout populations, and the numbers that constitute a potential harvestable surplus.	Bull trout population and fisheries model (BULLSIM v2.0) simulations have demonstrated that bull trout populations can not be sustained without restrictive angling regulations given reasonable estimates of fishing effort, catch and release mortality, and illegal harvest (Post & Paul 2000).
BLTR Plan (6) Review and update bait bans to reduce hooking mortality on bull trout.	A review of all bait bans in the Eastern Slopes was completed during the Eastern Slopes Regulations Review process in 1997. Bait use was eliminated except in a few areas/times (using only maggots) where there was a low likelihood of bull trout capture.
BLTR Plan (1.d) Investigate the use of a barbless hook only regulation for its potential to reduce hooking mortality and implement appropriate regulations based on study findings.	No studies of a barbless hook regulation were done in Alberta on bull trout, however a large body of current literature indicates that there is no statistically valid evidence that barbless hooks significantly reduce hooking mortality in trout. However, although not an initiative related to implementation of the bull trout management plan, a province wide barbless hook regulation was implemented in 2004 and remains in effect.
BLTR Plan (5) Review and update permanent, all year and seasonal water body closures so that bull trout life stages are protected based on geographical timing differences among bull trout populations.	The process of identifying permanent and seasonal angling closures to protect key sites is ongoing, with several new closures being added over the last several years. See Appendix 2.
BLTR Plan (7) Maintain a large minimum-size limit with a strict catch limit where some harvest of large bull trout can be permitted.	The province-wide zero harvest, catch and release only regulation remains in effect. There are only a few populations in the province where adequate data exists to consider permitting a small amount of bull trout harvest, e.g., Lower Kananaskis Lake. Any potential harvest would require very restrictive regulations, e.g., a draw and tag system, to limit harvest and angling effort (hooking mortality), as well as intensive monitoring of the bull trout population.

PUBLIC EDUCATION, INVOLVEMENT & ENFORCEMENT	
BLTR Plan (2) Communicate to the public the management and biological requirements for bull trout conservation, and promote public involvement in the management and recovery of bull trout, to be delivered on a continuing basis.	The Bull Trout Task Force (1993 – 97) was established as an interagency/public round table to spearhead initial bull trout conservation efforts. The designation of bull trout as Alberta's official fish emblem in 1995 provided an important public awareness and support campaign. The designation of bull trout as a "Species of Special Concern" in 2002 provided further public awareness regarding status and conservation management issues. Other communication efforts have included: • "Save the Bull Trout" poster campaign provided information about bull trout population decline and species biology as well as conservation measures required for recovery. • Bull Trout Panel Displays were developed for use at sportsman shows, offices, trade fairs and other venues. • A wide variety of bull trout related information and reports have been made available from the Sustainable Resource Development and Alberta Conservation Association websites. Information resources available from the SRD Information center include: • Alberta's Bull Trout Management and Recovery Plan (1994) • Alberta's Threatened Wildlife Series – Bull Trout (1994) • VHS video: (1) Bull Trout – Return of the River Wolf (1997) and (2) Highwood Trout Study – Bull Trout Research (1998) • Bull Trout Teacher's Guide (1999)
BLTR Plan (3) Educate anglers to identify bull trout and to distinguish between bull trout and other trout, especially brook trout: these education activities are to be delivered on a continuing basis.	"No Black – Put it Back" bull trout identification campaign was launched in 1993 and is still actively in use. The pamphlet "Trout Identification Guide for Alberta's Eastern Slopes Streams" is available from SRD offices and some fishing shops. Field signage program to remind anglers that 1) "You're in Bull Trout Country" and 2) "Zero Harvest In Effect" were developed and maintained. In addition, billboard size trout identification signs have been produced (by Trout Unlimited Canada) and installed at strategic locations through out the range of bull trout. The SRD website features publicly available information on bull trout. A fish identification education program was developed as part of the Quirk Creek Brook Trout Suppression Project and was expanded to include all of Alberta's salmonids. The self-administered Fish Identification Test and Fish Identification Key were made available on the SRD website. For a complete summary of Education and Information efforts see Appendix 3.
BLTR Plan (8) Set priorities on district enforcement needs for public education, protection of critical bull trout habitat, and regulation enforcement; these priorities are to	Regional Enforcement Advisories have identified BLTR as a priority in Eastern Slopes Districts since the inception of the BLTR Mgmt Plan. However, results of BLTR-specific enforcement efforts/angler compliance are not tracked independently of general fisheries enforcement.

be set at the outset, and on a continuing basis.	The Stream Watch program was initiated in 2003 to increase the presence of enforcement on East Slope streams. This was an industry/angler-sponsored program to enhance compliance monitoring, angler education and awareness that included a focus on bull trout. This program was unfortunately terminated in 2012.

POPULATION ASSESSMENTS & ECOLOGY	
BLTR Plan (1.a) Inventory bull trout populations throughout their known range. *ESCC Conservation Action Statement (4)* Improve documentation of population size and trend.	Baseline fish inventory efforts have been ongoing throughout much of the bull trout's range by the Fisheries Management Branch, the Alberta Conservation Association, and other partners. The Cooperative Fisheries Inventory Program, a 9 year partnership between F&W, ACA and industry to survey streams within forest management areas concluded in 2003. The Fish and Wildlife Division bull trout working group concluded that historical stream monitoring programs for bull trout, while providing information on relative abundance, have focused on specific streams or known critical habitats, and have lacked the proper scale and design to permit an accurate assessment of population status. Monitoring protocols for stream populations are being redesigned, tested and refined to provide estimates of abundance, distribution and size structure of bull trout populations at the watershed scale.
BLTR Plan (4) Develop specific operational plans for each Fish Management Area that will provide site specific status of populations (high, medium, or low risk of extirpation, populations capable of supporting limited harvest, and areas in need of additional study).	The bull trout working group has conducted a population status and risk assessment using a semi-quantitative evaluation process patterned after an IUCN species status assessment methodology, similar to that used for bull trout assessments in the U.S. A total of 48 occupied core areas (+ 3 extirpated core areas), were identified and 47 were assessed (1 insufficient information). Core areas are habitat areas in watersheds that contain one or more closely linked bull trout subpopulations (genetically distinct stocks) that form a population unit. Core areas are the basic unit on which population status was gauged. The core area risk assessment will help prioritize and direct inventory, monitoring and recovery efforts, and be used in large scale land use planning exercises.
BLTR Plan (1.b) Conduct specific studies of life-history, including movements and critical habitat requirements.	Research has included identifying key spawning, rearing and overwintering areas; migratory movements; population dynamics; interaction with competing species; habitat requirements and cumulative effects of industrial development. Much of this work has been reported in a series of bull trout conferences (I & II) and forest lands – fish conferences (I & II) held from 1994 - 2004. See References and Literature Review of Bull Trout in Alberta.
BLTR Plan (1.f) Determine the importance of mountain whitefish, and other fish, as prey species for bull trout.	Research in this area has been limited.

HABITAT	
BLTR Plan (1.e) Conduct studies to understand the interaction between land use impacts and natural events that limit or enhance bull trout populations.	Research on the impacts of land use disturbance on stream ecosystems and watersheds has been conducted by agencies across Alberta, B.C., and the U.S. resulting in a large body of work. Some of this work has been reported in the bull trout conferences (I & II) and forest lands – fish conferences (I & II) held from 1994 - 2004. See References and Literature Review of Bull Trout in Alberta. Recent research includes investigating the cumulative effects of the increasing levels of industrial development occurring in the eastern slopes watersheds. Impacts to bull trout habitat include: • Stream fragmentation caused by the widespread use of culverts as stream crossing structures. • Increases in peak flows associated with increased forest harvesting, land disturbance and access proliferation which can alter channel morphology, substrate types, and instream cover. • Increased sediment and thermal inputs.
ESCC Conservation Action Statement (2) Document the current extent of habitat fragmentation due to human impacts.	Stream crossing assessments and fragmentation modeling have been conducted in several north western Alberta watersheds and more recently in the Foothills Area of the Eastern Slopes. Results have shown that a high percentage of culverts become barriers resulting in significant fragmentation of stream watersheds.
ESCC Conservation Action Statement (3) Develop and implement programs to restore connectivity and prevent future habitat fragmentation.	A cross-ministry, stream crossing task group has been established to improve stream crossings. The Foothills Watershed Remediation Initiative is collaboratively working with industry to prioritize and remediate problem crossings in the upper Athabasca River. Plans are being developed to progressively correct these problem crossings on a priority basis. The work will be guided by an MOU being finalized between the Federal Department of Fisheries and Oceans, Alberta Environment and Alberta Sustainable Resource Development.
ESCC Conservation Action Statement (6) Integrate into Government land and water regulated activities, the necessary policy and strategies to maintain current bull trout habitat.	Numerous initiatives over the last number of years have included consideration of bull trout habitat requirements: -Restricted Area Review for Aquaculture. -Alberta Environment Water Act Code of Practice: • Identifies key bull trout habitats. • Recommends preferred stream crossing types in critical habitats and restricted activity periods. (Summary of current Class A and B designation in Appendix 4) -Alberta SRD Provincial Operating Ground Rules for Detailed Forest Management Planning • Including riparian policy, access management, watershed disturbance limits. -Water For Life Program in the South and North Saskatchewan Basins. -Land Use Framework planning activities on east slope systems now include fish community sub-models that model Bull Trout. -East Slopes Mountain Pine Beetle Response Plan - Watershed Rankings partly based on bull trout presence. -Access Management Plans under the Integrated Land Management

	Program. -Alberta Biodiversity Monitoring Institute Program Support. -Fish Sustainability Index • will be used to build a revised species management framework, linking bull trout population status to desired outcomes via management tools.
INVASIVE SPECIES	
ESCC Conservation Action Statement (5) Mitigate/resolve current issues and prevent future negative impacts from stocking programs in bull trout habitat.	All stocked waters with outflows in bull trout range have been identified, mapped, and escapement potential assessed. Stocking of brook and brown trout has been modified or discontinued where there is a risk of escapement. Additionally, the Provincial Fish Culture system is developing a triploid (sterile) brook trout program to further reduce escapement concerns. Efforts to remove brook trout in Quirk Creek and Canmore Creek using angling, electrofishing or trapping have determined it to be a difficult, complex and long-term process.
BLTR Plan (1.g) Determine the impact of hybridization with brook trout on the genetics, sterility and population extinction of bull trout.	Using genetic analysis, the Quirk Creek Project confirmed bull trout (stream-resident population) and brook trout hybridization. Analysis results: • Hybrids generally comprised < 4% of the catch, ranging from 0.5 – 12 %, over the years. • At some sampling events hybrids outnumbered bull trout. • Some hybrids were F2 backcrosses; indicating that some hybrids are fertile. Mill Creek (Oldman basin) contains both brook and bull trout (fluvial/adfluvial). Bull trout appear to have resisted brook trout invasion, both ecologically and genetically. Factors that maintain this relationship are being investigated but may be the result of: • Migrant populations may be more resistant than resident populations due to morphological or spawn timing differences, or they avoid direct competition with brook trout by moving to optimal bull trout habitats. • Bull trout populations in optimal habitat may be more resistant to brook trout. On a provincial scale, there has been limited genetic collection/analysis for hybrids, and the full extent of hybridization is unknown.
BLTR Plan (1.h) Measure the level of competition between bull trout and introduced species such as brook trout and brown trout under condition of reduced angling pressure.	Studies exploring temperature regimes and interspecific competition have shown that increased water temperatures favour brook trout. However, some bull trout populations seem to have been resistant to brook trout invasion. The mechanisms that determine why some local bull trout populations appear to be resistant are being investigated. A large amount of work has been done on bull trout in Alberta since the completion of the Management and Recovery Plan in 1994, a bibliography of that work is contained in Appendix 5.

7.0 CONSERVATION AND MANAGEMENT GOALS, OBJECTIVES & ACTIONS

Biologically diverse and productive ecosystems maintain healthy fish populations that provide social and economic benefits for Albertans. Achieving sustainability of bull trout populations and other aquatic resources require that these resources, and the ecosystems that support them, be managed to ensure their long-term viability and productivity, and are maintained for the benefit of future generations.

Guiding Principles:

- The biological diversity of bull trout populations is to be maintained, and the depletion or extirpation of populations, subpopulations or unique strains must be avoided.
- Bull trout populations are to be maintained by natural reproduction where ever possible. (except where restocking is required to re-establish self sustaining populations in waters from which the species has been extirpated)
- There should be no net loss of the productive capacity of bull trout habitats.
- The management of bull trout will be conducted on the basis of fundamental ecological principles and factual information.
- Public involvement and education is part of the management process.

Goal:
To restore and maintain viable, self-sustaining bull trout populations throughout the majority of the species' historic range in the province, and to once again provide some measure of harvest opportunity for the species.

Objectives:
The bull trout Conservation and Management Plan contains four main objectives patterned after the structure of the Fish Conservation Strategy for Alberta 2006-2010:

1. Habitat Maintenance: To sustain the quality and quantity of bull trout habitat and to restore and develop bull trout habitat where possible and appropriate.
2. Fish Population Management: To maintain robust, self-sustaining and interacting bull trout populations for all life-history types across their native range.
3. Fishing Opportunities: To maintain and provide a high quality and number of fishing opportunities for bull trout while managing use and harvest at sustainable levels.
4. Public Involvement: To engage the public and non-government agencies in the management of bull trout and their habitats.

Each of the objectives contains a number of more specific sub-objectives and actions aimed at achieving the goal.

7.1 Objective 1: Habitat Maintenance

To sustain the quality and quantity of bull trout habitat and to restore and develop bull trout habitat where possible and appropriate.

7.1.1 Sub-objective: Habitat Protection

To maintain the productive capacity of aquatic habitats to support healthy and diverse bull trout populations across the species' range.

Actions

- Continue to work with AB Environment on implementing and monitoring *Water Act Codes of Practice* protection for bull trout habitats:
  - Periodic review of Water Act Codes of Practice designations (Appendix 2) to ensure that critical habitats for bull trout populations are classified and updated as new information becomes available.
  - Work to eliminate the "Green Zone Exemption" for stream crossings.
- Advocate for protection of known key spawning areas by recommending to land managers:
  - Minimization of road development within 2 kilometres of spawning areas.
  - Avoidance of stream crossings within 2 kilometres upstream of spawning areas; use of single-span bridges for crossings; and ensuring that sedimentation and erosion are fully controlled.
  - Permanent elimination and reclamation of any vehicle fords within two kilometers upstream of spawning areas.
  - Avoidance of development of recreational trails, facilities or structures immediately adjacent to spawning areas.
- Increase collaborative efforts with the Department of Fisheries and Oceans (DFO) – the primary regulatory agency responsible for the protection of fish habitat in Canada – to encourage the organization to place emphasis on conservation and protection of bull trout habitat, and to lend support for strong enforcement actions in cases of bull trout habitat damage.
- Develop cumulative effects thresholds (road density and percent watershed disturbed) for watersheds at the 3rd order stream level and promote their implementation in managing land use.
- Continue to work with other government agencies, industry and the public, at both strategic and operational levels, to advocate and implement habitat protection strategies that will:
  - Maintain the connectivity of rivers and streams to prevent fragmentation and subsequent isolation of populations (i.e., retain open migratory routes). Recommend alternatives to development of dams. Pursue cooperative agreements with agencies and industry to restrict the use of culverts to non-fish bearing streams. Crossing structures over fish bearing streams should preserve the natural streambed and not constrain the active channel.
  - Ensure that water quality parameters, such as stream temperature and sedimentation, remain within the range necessary to sustain all life stages of bull trout.

- Maintain natural groundwater flow at spawning sites by restricting groundwater withdrawal affecting these sites, and road development and other disturbances in groundwater source areas.
- Minimize livestock and vehicle access to aquatic and riparian habitats of bull trout streams.
- Ensure the maintenance of intact riparian areas to protect streams from excessive increases in water temperature, to aid in the maintenance of channel stability, and to provide cover and recruitment of large woody debris to bull trout streams.
- Ensure that water yield and peak flows are not altered to the extent that impacts occur to natural channel morphology, substrate composition and instream cover.
- Ensure that Instream Flow Needs are adequately identified and maintained on a watershed basis.

7.1.2 Sub-objective: Habitat Restoration

To restore the productive capacity of bull trout habitats where human activities or natural events have impaired that capacity.

Actions:

Bull trout habitat restoration will be managed at a watershed or operational level as a component of the core area recovery plan in order to assess and prioritize habitat impacts, key limiting factors and restoration approaches. Habitat restoration assessments and efforts should address the following recommendations:

- Develop co-operative partnerships with other government agencies, industry and public stewardship groups to conduct habitat assessments and restoration efforts.
- Restore the connectivity of streams through watershed restoration programs that include: 1) audits of stream crossings to identify blockages, and 2) remedial action plans to replace aging and failed culverts with bridges where appropriate.
- Promote the replacement of culverts on all bull trout streams with structures that have open bottoms and maintain the natural stream bed.
- Restore the connectivity of rivers fragmented by dams through the development and/ or restoration of fish passage facilities or through mitigation programs.
- Reduce the impact of hydroelectric power generation by reducing/eliminating reservoir drawdown and hydro-peaking impacts in the river downstream of dams.
- Reduce the impact of flow regulation and water extraction by establishing minimum flow requirements that protect all bull trout life history stages present in affected streams.
- Reduce or prevent fish entrainment in canal intakes through the development of fish passage barriers on headwork structures.
- Reduce the impact of road networks by obtaining rapid revegetation and stabilization of disturbed areas, and by deactivating and reclaiming temporary, abandoned and inactive roads.
- Reduce the impact of OHV trail networks through legislative controls such as *The Land Stewardship Act* and *Access Management Plans* that restrict the use of OHV to designated areas or trails.

- Reduce vehicle and OHV stream crossing impacts through the installation of appropriate crossing structures to reduce/eliminate fording, and encourage a habitat protection enforcement program for non-designated areas directed at curbing uncontrolled and unnecessary OHV use in watercourses.
- Identify sedimentation sources, caused by roads and other land-use activities, for remedial stabilization.
- Restore degraded riparian areas.

7.1.3 Sub-objective: Habitat Development

To enhance bull trout production through habitat manipulation where feasible and appropriate.

Actions

- Habitat development and enhancement activities will be included as an element of core area recovery planning where appropriate.
- Potential enhancement projects to be listed and used as required mitigation to offset in-stream works by development proponents.

7.2 Objective 2: Fish Population Management

To maintain robust, self-sustaining and interacting bull trout populations for all life-history types across their native range.

7.2.1 Sub-objective: Species Management Planning

To develop strategic and operational level plans to achieve management goals for each core population unit.

Actions

- Revise and update the provincial bull trout management plan every 5 – 10 years.
- Establish a provincial bull trout species management lead to provide a coordinated provincial level approach to overseeing management actions.
- Bull trout population recovery and status will be assessed and managed through the development of core area recovery plans for all areas by 2017. Core areas may be grouped into recovery units on a larger basin or watershed basis to reduce duplication of effort. Recovery units that contain high risk core areas, are isolated or contain sub-populations at risk of extirpation (below 100 fish) should be prioritized for planning.
- Develop a standardized bull trout recovery unit planning guide for Alberta to provide a template for planning and to ensure use of a consistent methodology.
- Develop core area recovery plans, including the following elements:

- Population status:
  -Assessment of abundance and distribution.
  -Identification of life-history types and metapopulation structure.
  - Identification of information gaps for further inventory efforts.
  - Mapping of key habitats – spawning areas, staging reaches, overwintering reaches, rearing tributaries, etc.
  - Habitat maintenance and recovery – assessment of habitat impacts including stream fragmentation, road densities, total area of disturbed landbase (that could contribute to hydrologic changes) and use of resulting information to prioritize recovery efforts.
  - Mapping the known extent of brook, brown, and lake trout distribution, to identify current and future risk from introduced competitive species.
- Pursue co-ordinated bull trout management and recovery plans for cross jurisdictional watersheds with managing agencies (Parks Canada, B.C. Ministry of Environment).
- Enhance and improve monitoring efforts:
  - Establish a review committee to modernize and standardize population monitoring methodologies used in bull trout surveys.
  - Evaluate previous bull trout surveys across the province to determine which ones are consistent with modern sampling designs and can be repeated in the near future.
  - Create a list enumerating the waterbodies that Alberta Fish & Wildlife will begin, or continue, to monitor in the near future.
  - Establish a prioritized monitoring cycle for each of these waterbodies.
  - Update population status for bull trout populations that have a baseline dataset available.
  - Improve the organization, tracking and process for prioritization of population estimates and abundance indices.
  - Conduct additional baseline inventory to determine key habitats and population status for those core areas with limited data.

7.2.2 Sub-objective: Fish Production Maintenance

To maintain a wide distribution of bull trout populations at levels that meet conservation goals and societal expectations.

Actions

Regulations

- Continue to manage bull trout on a general provincial zero harvest basis, while assessing individual populations for controlled harvest opportunities.
- Conduct research into the level of hooking mortality of bull trout resulting from catch and release angling.
- Conduct periodic review, and updating at 5 year intervals, of year round and seasonal fishing closures (that were established to reduce/eliminate disturbance to spawning and rearing activities, hooking mortality, misidentification and illegal harvest in key bull trout habitats).
- Maintain bait bans in bull trout waters to reduce hooking mortality.

Management

- Strive for a target of 1000 spawning adults as a minimum effective population within core areas and a minimum target of 100 spawners per subpopulation.
- Where subpopulations cannot support the minimum number of adult spawners, the goal is to conserve a network of interconnected subpopulations totalling a minimum 1000 spawning adults.
- Maintain large migratory individuals in fluvial and adfluvial populations due to their potential importance in genetic exchange and reestablishment of populations.
- Identify key bull trout populations as "provincially or regionally significant" and prioritize for a higher level of population and habitat management effort and protection.
- Continue to compile genetic profiles on bull trout populations to aid in conservation and recovery planning and implementation .

Enforcement

- Strictly enforce regulations that protect bull trout populations and critical habitat areas identified in District Enforcement Priority planning.
- District Enforcement Priority planning should include a focus for remote areas. Activities should include expanding remote location patrols on bull trout streams, encouraging the public to report suspected violators and tracking the results of bull trout enforcement patrols.
- Develop an enhanced system of recording and reporting on compliance efforts and violation detection specific to bull trout.
- Incorporate a public information and education program, emphasizing the management needs of bull trout, into the annual work plan for enforcement priorities in each Fish & Wildlife District within bull trout range.

Introduced competitive species

- Prevent further introduction of brook or brown trout into bull trout waters by continuing to assess the escapement potential of stocked waterbodies, and either discontinue stocking or switch to sterile (triploid) fish where escapement risk exists.
- Prevent further introduction of lake trout into waterbodies containing adfluvial bull trout populations.
- Manage introduced competitive species at reduced population levels in priority bull trout waters.
- Develop/expand program to reduce the potential for misidentification and illegal harvest of bull trout while facilitating the harvest of introduced competitive species (e.g., Stewardship Licence).

Monitoring

- When conducting watershed-scale inventory, include genetic analysis to refine knowledge of genetic diversity and metapopulation structure. Understanding genetic uniqueness of populations may also help to determine level of risk and direct future monitoring efforts

7.2.3 Sub-objective: Fish Production Restoration

To restore diminished bull trout production to full production wherever possible.

Actions

- Bull trout population recovery will be assessed on a core area recovery plan basis in order to assess current and historical population levels, habitat carrying capacity and recovery targets.
- Prevent the extirpation of subpopulations (i.e., stocks) by prioritizing recovery efforts for subpopulations that have been reduced below a minimum effective population size of 100 adults, where factors influencing decline can be reversed.

Introduced species

- Evaluate the factors that have contributed to bull trout recovery where this has occurred despite the presence of introduced competitive species.
- Continue investigations in the dynamics of removing introduced competitive species as a means to recover bull trout populations.
- Prioritize watersheds for efforts to remove introduced competitive species.
- Conduct additional investigation to determine the extent of hybridization.

Bull trout stocking

- Establish clear direction on the use of bull trout stocking and transfers that places a priority on maintaining the genetic integrity of stocks. Until this policy direction is established, only within sub-population transfers will be permitted.
- Bull trout stockings or transfers could be considered to re-establish extirpated populations using genetically compatible strains, where limiting factors have been reversed. Obtaining source stock must follow a hierarchy of watersheds staying within the drainage (i.e., use fish from closest watersheds with available fish first).
- Investigate the potential use of hatcheries in bull trout recovery, which could include the establishment of genetic reserves for declining populations followed by restoration stocking, where limiting factors have been reversed.

7.2.4 Sub-objective: Fish Production Enhancement and Development

To enhance or develop new bull trout production where suitable unoccupied habitat exists, and is considered appropriate and feasible.

Actions

- Bull trout populations may be considered for establishment where suitable unoccupied habitats exist (e.g., above barrier falls, etc.) using genetic stock from the same watershed. An "Introductions and Transfers" assessment must be completed to ensure careful consideration is given to ecological consequences of the introduction on the receiving ecosystem (e.g., changes in amphibian or invertebrate communities). Generally, the maintenance and restoration of naturally occurring bull trout populations in healthy aquatic ecosystems are the primary objectives of bull trout management, and expansion of the species into historically vacant habitats remains a low priority.

7.3 Objective 3: Fishing Opportunities

To maintain and provide a high quality and number of fishing opportunities for bull trout while managing use and harvest at sustainable levels.

Bull trout are vulnerable to overharvest even at low levels of angling effort. As a result, open harvest fishing seasons are not considered sustainable, even in recovered populations with harvestable surpluses.

7.3.1 Sub-objective: Aboriginal Food Fishery Use

To manage food fishing within the constraints of fish conservation, constitutionally protected rights and traditional uses.

Actions

- Consult with First Nations to clearly advise them of the current provincial zero harvest regulation in effect on bull trout, and that this regulation is for conservation and recovery purposes and as such applies to all user groups.
- Continue to manage bull trout on a zero-harvest basis until specific populations with sufficient surplus stock to support controlled harvests are identified.
- Consult with First Nations regarding any future regulation changes.
- A tag system or very large minimum size limit (e.g., 70 cm) may be options to provide some harvest opportunity for specific recovered populations with harvestable surpluses.

7.3.2 Sub-objective: Recreational Use

To provide for recreational fishing within the constraints of fish conservation and subsistence fishing.

Actions

- Continue to manage bull trout on a zero-harvest basis until specific populations with sufficient surplus stock to support controlled harvests are identified.
- Consider a tag system or very large minimum size limit (e.g., 70 cm) as options to provide some harvest opportunity for specific recovered populations with harvestable surpluses.
- Opportunities for stocked fisheries may be investigated, in locations where bull trout could be stocked for harvest without impacting naturally occurring populations(e.g., Upper Kananaskis Lake).

7.3.3 Sub-objective: Commercial Use

To provide for commercial and competitive fishing opportunities, within the constraints of fish conservation, subsistence fishing and recreational fishing.

Actions

- Continue to allow commercial guiding of sport anglers in bull trout waters within current sportfishing regulations.
- Continue to prohibit commercial harvest opportunities, including competitive fishing events, because bull trout populations can not support these activities.

7.4 Objective 4: Public Involvement

To engage the public and non-government agencies in the management of bull trout and their habitats.

7.4.1 Sub-objective: Public Consultation

To obtain input from all users on their views and expectations for the condition and availability of bull trout populations in the province.

Actions

- Consult other government agencies and industry in developing and adopting operational strategies that protect bull trout habitat and populations.
- Consult with a broad range of user and conservation groups as well as the interested public regarding bull trout management and recovery activities.
- Consult with First Nations regarding bull trout management and recovery activities.

7.4.2 Sub-objective: Education and Outreach

To continue to provide the public with an understanding of bull trout conservation and management issues in Alberta (Appendix 3).

Actions

- Continue to inform the public through a wide range of communication methods to convey information regarding:
    - Bull trout identification/misidentification.
    - Population status and management.
    - The sensitivity of bull trout populations to both habitat disturbance and harvest.
    - Reasons for continued protection, as well as the effects of unintentional harvest (misidentification), intentional illegal harvest (poaching), and hooking and handling mortality.
- Maintain fish identification education as a program priority including:

- Provide the "Trout Identification in Eastern Slopes Streams" pamphlet in the sportfishing regulations as an insert or pullout on a regular basis and/or provide supplementary fish identification pamphlets at licence vendors.
- Maintaining field signage identifying (1) "You are in Bull Trout Country" and (2) "No Black Put It Back".
- Restore fish identification course/quiz on SRD website and continue to provide information on bull trout status, management and biology.

- Continue to publicly profile enforcement actions on illegal harvest and penalties for such actions.
- Provide messaging regarding the statues of streams where bull trout have been extirpated.

7.4.3 Sub-objective: Public Stewardship

To encourage fish resource users and others to take the initiative to manage their activities and actions in a manner that will consider and protect bull trout populations and the habitat upon which they depend.

Actions

- Promote stewardship programs for landowners on private land, and industry and recreationalists on crown land to protect and restore riparian areas and watersheds.
- Continue to work in partnership with fish user and stewardship groups in both education and habitat initiatives.
- Continue to conduct carefully controlled pilot projects, with assistance from anglers who have passed a fish identification test, to increase harvest of brook trout from select streams to determine if bull trout populations will benefit.
- Continue to promote enforcement-related programs (Report A Poacher, etc.)

While bull trout recovery and management has remained a priority for the Province, and Fisheries Management Branch in particular, program delivery has suffered from a lack of provincially coordinated approach by an individual who has bull trout management and recovery as a major component of their responsibilities. As per " Alberta's Strategy for the Management of Species At Risk" (Fish and Wildlife Division, 2008), establishing a Divisional biologist as a bull trout species lead would provide a coordinated approach to planning, inventory, monitoring and habitat protection efforts.

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10.0 APPENDICES

Appendix 1. Short – term Trend Category Descriptions

1. **Severely Declining:** Decline of > 70% in population, range, area occupied, and/or number or condition of occurrences.
2. **Very Rapidly Declining:** Decline of 50 to 70% in population, range, area occupied, and/or number or condition of occurrences
3. **Rapidly Declining:** Decline of 30 to 50% in population, range, area occupied, and/or number or condition of occurrences.
4. **Declining:** Decline of 10 to 30% in population, range, area occupied, and/or number or condition of occurrence.
5. **Stable:** Population, range, area occupied, and/or number or condition of occurrences unchanged or remaining within +/- 10% fluctuation.
6. **Increasing:** Increase of > 10% in population, range, area occupied, and/or number or condition of occurrences.
7. **Unknown:** Short-term trend unknown.

Appendix 2. Bull Trout-Specific Angling Closures

Oldman River Basin

- Belly River – Sept. 1 closure
- Mill Creek – Sept. 1 closure

Bow River Basin

- Elbow River from Elbow Falls to Canyon Creek – Closed
- Smith-Dorrien Creek and NW bay of Lower Kananaskis Lake – Closed
- Sheep River from bridge at Indian Oils Day-use Site to Gorge Creek – Closed
- Storm Creek – Closed

Red Deer River Basin

- Pinto Creek and tributaries (trib to N. Burnt River) – Closed

North Saskatchewan River Basin

- Blackstone River and tributaries u/s of and including Mons Creek – Closed
- Clearwater River tributaries u/s of and including Timber Creek – Closed
- Fall Creek and tributaries d/s of the falls – Closed
- Lake of Falls outlet and tributaries – Sept. 1 closure
- Pinto Lake and tributaries and outlet for 1.5 km – Closed
- Rundell Creek and tributaries – Closed
- Unnamed Creek & tributaries (4-45-16-W5; tributary to Brazeau River) – Closed
- Unnamed (Jumpingfish) Lake, inlets, outlet and tributaries to outlet (30,31-44-17-W5; tributary to Brown Cr.) – Closed

Athabasca River Basin

- Mackenzie Creek & tributaries – Closed

Peace-Smoky River Basin

- Muskeg River and tributaries u/s and d/s of falls – Sept. 1 closure
- Grizzly Creek – Closed
- Lynx Creek – Closed

Appendix 3. Summary of Bull Trout Public Education and Awareness Efforts 1994 - 2010

The Bull Trout Management and Recovery Plan (Berry 1994) recognized the need for public education and awareness to enable effective species management and achieve population recovery. Management plan action items include:

1. Communicate to the public the management and biological requirements for bull trout conservation, and promote public involvement in the management and recovery of bull trout.
2. Educate anglers to identify bull trout and to distinguish between bull trout and other trout [to prevent the misidentification of and unintentional harvest of bull trout].

Actions taken in pursuit of these objectives include:

Bull Trout Task Force (1993 – 1997)

The Bull Trout Task Force (BTTF, 1994) was developed as an interagency/public task force to spearhead the initial public education and awareness campaign including:

- Designation of bull trout as Alberta's official fish emblem in 1995. Provided the public awareness campaign a platform for media interviews, petition gathering, letters and support from MLAs and stakeholders.
- "Save the Bull Trout" poster campaign. To increase public awareness of: 1) why the species is in decline, 2) why conservation of individual fish is needed, 3) bull trout, 4) to recommend release. Launched in 1993 and adapted by other jurisdictions.
- "No Black – Put it Back" Slogan. Launched in 1993, still actively in use.
- Stream-side signage program. To improve awareness and regulation compliance. Two types of all-weather signs were developed and posted to 1) remind anglers about harvest restrictions, and 2) identify to anglers "You're in Bull Trout Country". Signage actively maintained.
- Bull Trout Conferences, 1994 and 1999. Brought government and non-government agencies together to share results of research and management program development.

AB Fishing Regulations (annually)

- Emphasizes bull trout zero limit with sidebar on all Eastern Slopes pages.
- Emphasizes bull trout identification with "no black put it back" sidebar.
- Regulations included special section titled 'Annual Report on the State of AB Fisheries' from 1997 – 2001 that included bull trout findings.

Salmonid Identification Education

A fish education program was developed as part of the Quirk Creek Brook Trout Suppression Project to ensure participating anglers could identify the three salmonids in

the study area. The fish identification program was subsequently expanded to include other common stream salmonids in Alberta and developed as course material for distribution to all Fish and Wildlife area offices, and was available on the SRD external website to 2009.

- Stelfox, J.D., D.M. Baayens, and D.K. Berry. 2000. Alberta's salmonid identification course. Alberta Environment. Alberta Fish & Wildlife Division.
- A pictorial paper pocket field guide 'Trout Identification Guide for Alberta's Eastern Slopes Streams' is also available.

Resources available from the SRD Infocenter (srd.alberta.ca/informationcentre - accessed Feb/08):

- Trout Identification Guide for Alberta's Eastern Slopes Streams.
- Alberta's Bull Trout Management and Recovery Plan (D. Berry, 1994).
- VHS video: Bull Trout – Return of the River Wolf (1997).
- VHS video: Highwood Trout Study – Bull Trout Research (1998).
- Bull Trout: Teacher's Guide (1999).
- Bull Trout Poster
- Alberta's Species at Risk Brochures

External SRD Fish & Wildlife website (srd.alberta.ca/fishwildlife - accessed Feb/08)

- Fish identification site including: (1) salmonid pictures with field marks and additional photos, (2) a dichotomous key for salmonids, (3) salmonid identification quiz.
- Game fish summary: *Bull Trout*. Very brief overview, 1 pp., as html file.
- Status of AB Wildlife: Report – Status of the Bull Trout in AB (Post and Johnston 2002). Detailed report, 40 pp., as pdf file.
- Species at Risk Profiles: Alberta's Threatened Wildlife Series – Bull Trout (1994). Overview, 6 pp., as html file.
- AB ESCC Fact Sheets: Species of Special Concern - Alberta's Bull Trout (2003). Overview, 2 pp., as pdf file.
- Species at Risk - Program Report #14: Cumulative effects of watershed disturbances on fish communities in the Kakwa and Simonette watersheds (2001). Detailed report, as pdf file.

Other selected Alberta websites with publicly accessible bull trout information:

- Alberta Conservation Association (www.ab-conservation.com). Reports detailing inventory, habitat and cumulative effects research results, regularly updated as new additions become available, as pdf files.
- Trout Unlimited (www.tucanada.org). Provides access to bull trout related reports.
- Fishing Alberta (www.fishalberta.com). General information on bull trout identification, biology and management in html.

Appendix 4. Bull Trout Class A and B Waterbodies – Water Act Codes of Practice

The *Codes of Practice* regulate activities under the *Water Act* that would normally require an approval to be obtained. The *Codes of Practice* establishes the objectives, standards and conditions to be met when undertaking the activity to ensure that impacts to the environment are minimized.

There are three applicable *Codes of Practice:*

- *Code of Practice for Watercourse Crossings.*
- *Code of Practice for Pipelines and Telecommunication Lines Crossing a Waterbody.*
- *Code of Practice for Outfall Structures.*

Alberta Environment, as the government department responsible for the administration of the *Water Act*, monitors and audits for compliance, and enforces the *Codes of Practice* requirements. Alberta Fisheries Management Branch has participated in the development of the Codes of Practice to provide professional advice in the protection of aquatic resources.

Under the *Codes of Practice* waterbodies are classified by fish habitat sensitivity to disturbance. The two highest sensitivity ratings, Class A and B waterbodies, are listed in Table 1.

Class A waterbodies: Highest sensitivity; habitat areas are sensitive enough to be damaged by any type of activity within the waterbody; known habitats in waterbody critical to the continued viability of a population.

Typical restrictions: New crossings discouraged. Replacement and maintenance of existing crossing structures allowed.

Class B waterbodies: High sensitivity; habitat areas are sensitive enough to be potentially damaged by any type of activity within the waterbody; habitat areas important to the continued viability of a population.

Typical restrictions: Type 1 crossing (single span bridge) preferred. Replacement and maintenance of existing crossing structures allowed.

- For pipeline and telecommunication crossings trenchless methods preferred.
- Restricted activity windows in place.

Alberta Bull Trout Class A and B Waterbodies. Data from Codes of Practice, Management Area Map series – November, 2006.

Waterbody	Class	Location	Comments
Grande Prairie Area			
Confluence of Caw and Copton creeks	A	Sec 11,12,13,14,24 - 59 - 11 - W6	Spawning, rearing, overwintering habitat.
Copton Creek	A	Sec 28, 33,34 - 59 - 9 - W6 Sec 3,4 - 60 - 9 - W6	Spawning, rearing, overwintering habitat.
Lynx Creek and tributaries	A	Sec 34,35 - 59 - 12 - W6 Sec 2,11,12 - 60 - 12 - W6 Sec 7,18,19,29,30,32 - 60 - 11 - W6	Spawning habitat.
Prairie Creek	A	Sec 32 - 59 - 8 - W6 Sec 4,5 - 60 - 8 - W6	Habitat.
Unnamed tributary of Copton Creek (Grizzly Creek)	A	Sec 32 - 59 - 8 - W6 Sec 4,5 - 60 - 8 - W6	Spawning, rearing, overwintering habitat.
Unnamed tributary of Simonette River	A	Sec 32 - 59 - 8 - W6 Sec 4,5 - 60 - 8 - W6	Spawning habitat and key groundwater locations.
Beaverdam Creek	B	Sec 29,32 - 61 - 9 - W6 Sec 5,7,8,17,18,20,28 - 59 - 9 - W6	Habitat. Restricted activity period – Aug. 1 to July 15.
Caw Creek	B	Sec 26,27,28,29,31,32,33 - 58 - 10 - W6 Sec 6,7 - 60 - 10 - W6 Sec 12 - 60 - 11 - W6	Habitat. Restricted activity period – Aug. 1 to July 15.
Copton Creek The main drainage of Copton Cr. including Caw and Beaverdam creeks.	B	From Sec 9,10 - 61 - 9 - W6 To Sec 17 - 58 - 11 - W6	Habitat. Restricted activity period – Aug. 1 to July 15.
Daniel Creek and tributary	B	Sec 18,19,20,29,30,32 - 60 - 9 - W6 Sec 5 - 61 - 9 - W6 Sec 22,23,24,27 - 60 - 10 - W6	Habitat. Restricted activity period – Aug. 1 to July 15.
Lynx Creek and	B	Sec 2,11,12,16,21,22,25,26,27,35,36 - 60	Spawning habitat. Restricted activity period –

Waterbody	Class	Location	Comments
tributaries		- 12 - W6	Aug. 1 to July 15.
North Wolf Creek	B	Sec 32 - 59 - 8 - W6 Sec 4,5 - 60 - 8 - W6	Habitat. Restricted activity period – Aug. 1 to July 15.
Prairie Creek	B	From Sec 32 - 59 - 8 - W6 To Sec 4,5 - 60 - 8 - W6	Habitat. Restricted activity period – Aug. 1 to July 15.
Redrock Creek and tributary	B	From Sec 32 - 59 - 8 - W6 To Sec 4,5 - 60 - 8 - W6	Habitat. Restricted activity period – Aug. 1 to July 15.
Edson Area			
Bolton Creek and tributaries	A	Sec 6,7,18,19,20,29,32,33 - 59 - 4 - W6	Spawning and rearing habitat.
Little Berland River	A	Sec 5,6,8,17,20,21,28 - 54 - 2 - W6	Spawning and rearing habitat.
MacKenzie Creek and tributaries	A	Sec 7,15,18-22,28,29,32 - 46 - 22 - W5 Sec 5 - 47 - 22 - W5	Spawning and rearing habitat.
Mahon Creek	A	Sec 19,30,31,32 - 55 - 5 - W6 Sec 4,5 - 56 - 5 - W6	Spawning and rearing habitat.
Unnamed tributary of Bolton Creek	A	Sec 24,25,26,27 - 60 - 4 - W6	Spawning and rearing habitat.
Berland River and tributaries	B	From Sec 9 - 55 - 2 - W6 To Sec 6 - 55 - 3 - W6	Spawning and rearing habitat. Restricted activity period – Sept. 1 to July 15.
Bolton Creek and tributaries	B	From Sec 34 - 60 - 4 - W6 To Sec 4 - 58 - 5 - W6	Spawning and rearing habitat. Restricted activity period – Aug. 1 to July 15.
MacKenzie Creek and tributaries	B	From Sec 2,3,10,11 - 48 - 22 - W5 To Sec 26 - 45 - 23 - W5	Spawning and rearing habitat. Restricted activity period – Sept. 1 to July 15. This site provides water quality protection for adjacent Class A waterbodies.
Muskeg River and tributaries	B	From Sec 16 - 57 - 6 - W6 To Sec 16 - 55 - 6 - W6	The entire drainage system upstream of Hwy 40 is protected spawning and rearing habitat. Restricted activity period – Aug. 1 to July 15.

Waterbody	Class	Location	Comments
Rocky Mountain House Area			
Clearwater River and tributaries	A	Sec 25,26,34,35,36 - 33 - 13 - W5 Sec 7,8,18,19 - 34 - 12 - W5 Sec 1,2,3,12,13 - 34 - 13 - W5	Spawning habitat.
Pinto Lake outlet	A	Sec 36 - 36 - 21 - W5	Spawning habitat. For 1 km from the lake outlet downstream.
Unnamed tributary to Brown Creek	A	Sec 19,20,30,31,32 - 44 - 17 - W5	Spawning habitat.
Rundell Creek	B	From Sec 28 - 44 - 15 - W5 To Sec 30 - 43 - 15 - W5	Spawning habitat. Restricted activity period – Sept. 1 to April 30.
Unnamed tributaries to Brazeau River	B	Sec 19,29,30,31,32 - 44 - 16 - W5 Sec 24,33,34,35,36 - 44 - 17 - W5 Sec 5 - 45 - 16 - W5 Sec 3,4 - 45 - 17 - W5	Spawning habitat. Restricted activity period – Sept. 1 to April 30.
Canmore and Calgary Areas			
Smith-Dorrien Creek	A	From Sec 13 - 20 - 9 - W5 To Sec 16,21 - 21 - 10 - W5	Spawning habitat.
Storm Creek	A	Sec 5,6 - 25 - 10 - W5 Sec 28,29,32,33 - 24 - 10 - W5 Sec 19,20 30 31 - 18 - 7 - W5	Spawning habitat.
Unnamed tributary of North Burnt Timber Creek (Pinto Creek)	B	Sec 30,31 - 28 - 10 - W5 Sec 25 - 28 - 11 - W5 Sec 6-9,15,16,22,27,34,35 - 29 - 10 - W5	Spawning habitat.
Pincher Creek Area			
Castle River and tributaries	B	From Sec 28Twp 6 – Rge 2 – W5 To Sec 31Twp 2 – Rge 1 – W5	Spawning habitat. Restricted activity period – Sept. 1 to August 15.
Mill Creek	B	From Sec 20 - 6 - 1 - W5	Spawning habitat. Restricted activity period –

Waterbody	Class	Location	Comments
		To Sec 24,25 - 4 - 2 - W5	Sept. 1 to August 15.
Oldman River and tributaries	B	From Sec 9,10 - 8 - 1 - W5 To Sec 16 - 14 - 5 - W5	Spawning habitat. Restricted activity period – Sept. 1 to August 15.
Pincher Creek	B	From Sec 17 - 6 - 30 - W4 To Sec 1 - 4 - 2 - W5	Spawning habitat. Restricted activity period – Sept. 1 to August 15.
Unnamed tributary of Waterton River (Dungarvan Creek)	B	From Sec 19 - 3 - 28 - W4 To Sec 13 - 3 - 30 - W4	Spawning habitat. Restricted activity period – Sept. 1 to August 15.
Willow Creek	B	From Sec 28 - 14 - 2 - W5 To Sec 16 - 15 - 3 - W4	Spawning habitat. Restricted activity period – Sept. 1 to August 15.
Yarrow Creek and tributary	B	From Sec 8 - 4 - 29 - W4 To Sec 11 - 3 - 1 - W5	Spawning habitat. Restricted activity period – Sept. 1 to August 15.

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